

**Before the  
Federal Communications Commission  
Washington, DC 20554**

In the Matter of	)	
	)	
Promoting Investment in the 3550-3700 MHz	)	GN Docket No. 17-258
Band;	)	
	)	
Petitions for Rulemaking Regarding the	)	RM-11788 (Terminated)
Citizens Broadband Radio Service	)	RM-11789 (Terminated)
To:    The Commission		

**COMMENTS OF  
THE WIRELESS INTERNET SERVICE PROVIDERS ASSOCIATION**

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## Summary

Chairman Pai recently remarked that “the government shouldn’t be in the business of picking winners and losers in the Internet economy.”<sup>1</sup> But if the Commission follows through on its contemplated changes to the Citizens Broadband Radio Service (“CBRS”), it will contradict this principle and effectively gift 70 megahertz in the 3.5 GHz band to a handful of spectrum-rich mobile wireless carriers under a traditional licensing model that forecloses participation from small businesses and innovators. If CBRS is to remain a viable “new tool in the spectrum tool kit . . . to support a wide variety of use cases and deployments,”<sup>2</sup> the Commission must stay the course it charted in the 2015 *CBRS Order*<sup>3</sup> and reject the fundamental changes it is considering to its Priority Access License (“PAL”) rules.

With 23 million rural Americans unconnected to the digital economy, our nation faces the challenge of finding ways to bridge the digital divide. Fixed wireless technology is the most cost-effective way to expeditiously make affordable broadband available to unserved consumers. According to an analysis being submitted today by research scientist William Lehr, using fixed wireless technology instead of fiber to meet our nation’s rural broadband challenge could save the U.S. economy as much as \$60 billion in investment. Wireless Internet service providers (“WISPs”) need mid-band spectrum to connect customers in non-line-of-sight conditions, and to provide additional capacity in areas where the unlicensed bands are congested. CBRS spectrum is the only mid-band spectrum that can be made available to WISPs and other competitive providers in the near term, and the Commission should not modify the CBRS rules in a manner

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<sup>1</sup> *Restoring Internet Freedom*, WC Docket No. 17-108, Oral Statement of Chairman Ajit Pai (Dec. 14, 2017), at 4.

<sup>2</sup> *Promoting Investment in the 3550-3700 MHz Band; Petitions for Rulemaking Regarding the Citizens Broadband Radio Service*, Notice of Proposed Rulemaking and Order Terminating Petitions, 32 FCC Rcd 8071, 8112 (2017) (“*NPRM*”), Statement of Commissioner Brendan Carr.

<sup>3</sup> See *Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, 30 FCC Rcd 3959 (2015) (“*CBRS Order*”).



that will deprive rural America of the best near-term opportunity to obtain access to sustainable, high-quality broadband service. Hundreds of existing small broadband providers are standing ready to invest private, at-risk capital to put this spectrum to use to help connect the unconnected, and indeed, many have invested significant resources to do so under the current rules.

Despite a robust public record exposing the mobile carriers' efforts to remake the CBRS band into one that supports only their business model, the *NPRM* proposes to lengthen PAL license terms to ten years and allow PALs to be renewed indefinitely, and seeks comment on whether to dramatically enlarge the geographic areas that PALs would cover. The Wireless Internet Service Providers Association ("WISPA") strongly objects to these contemplated changes which, if adopted, will effectively foreclose participation in PAL auctions by smaller providers and strand millions of dollars in investment *already made* in reliance on the rules adopted in 2015. Indeed, as a recent survey of WISPA's operator members demonstrates, *60 percent* of those that have invested in software-defined equipment that can operate in the 3550-3650 MHz band reported that the mere threat of potential changes to the PAL rules is forcing reductions in ongoing investment, decelerating deployment in the rural areas where many WISPs operate.

The most important decision the Commission can make in this proceeding is retaining census tracts as the PAL geographic area. Under the current rules, bidders representing a wide variety of technologies and use cases can compete on a level playing field, and successful bidders can aggregate census tracts to create an appropriate spectrum footprint whether for *capacity* in densely populated areas or for *coverage* in rural areas. If the Commission were to yield to the singular interests of the mobile wireless industry and adopt Partial Economic Areas

(“PEAs”) as the PAL license area, it would effectively limit competition for those licenses to a few large companies and sideline innovators, entrepreneurs, and small operators. On average, for every one PEA there are 178 census tracts; at least one PEA has more than 6,000 census tracts and more than 80 percent have more than 100 census tracts. Companies whose business models are targeted to one or only a few census tracts should not be required to bid for an area that greatly exceeds the geographic scope of their intended deployment. Using counties as the PAL area does not solve the problem, as many counties – especially in Western states – are extremely large and variable in population density. In response to a concern raised by the mobile wireless industry, the record contravenes the claim that conducting auctions at the census tract level would be too complex. It would not. Simply put, consigning rural Americans to a future of increasingly congested unlicensed spectrum and limited General Authorized Access spectrum would remove the most essential tool in the spectrum tool kit for closing the digital divide.

The Commission also should reject proposals to extend PAL terms to ten years and to adopt a renewal expectancy that would make PALs effectively permanent. Unlike the business model envisioned by mobile carriers, which requires “multiple years” of standards, technology and equipment development, WISPs and others are poised to “flip the switch” on their 3650-3700 MHz equipment so it can operate across the entire CBRS band – something that can occur in a matter of months if the PAL rules are retained. Short-term licenses with limited renewability promotes availability of PALs when and where they are needed while permitting reassignment of spectrum rights as market conditions change over time.

The Commission suggests that build-out requirements, as well as the ability to partition and disaggregate large-area, long-term licenses, can somehow compensate for the lost benefits of the current rules. This is simply not true. Build-out requirements are an inferior substitute for

the innovative “use-it-or-share-it” licensing model the Commission adopted for this band, and they can be manipulated by nominal deployments that block commercial uses, a result the *CBRS Order* avoids. Moreover, secondary markets have already proved to be ineffective mechanisms for putting unused spectrum to use. Fewer than ten percent of respondents to WISPA’s recent survey reported success in obtaining spectrum rights from the large mobile carriers.

Changing the PAL rules also would contravene the mandates of Section 309(j) of the Communications Act, as amended. Establishing large license sizes and lengthy license terms would reduce, not expand, opportunities for new entrants; contravene the statutory directive to disseminate licenses to a wide variety of entities; and stifle competition before it can emerge. Changing the PAL rules also would undermine the statutory objective of ensuring “deployment of new technologies, products, and services for the benefit of the public, including those residing in rural areas.”

WISPA also comments on other potential rule changes. First, the Commission should apply its common definition of mutual exclusivity and adopt its proposal to make all available PALs available regardless of the number of bidders. Second, the Commission should retain the existing 40-megahertz limit on PALs in a given area. Third, the Commission should not allow bidding on specific spectrum within the CBRS band.

In addition, the Commission should reject its proposal to eliminate transparency regarding CBSD registration information. The existing rule enables disclosure of certain basic information that can assist in network design without revealing to the general public information that is not available from other sources. The Commission also should adjust the emission mask in the manner suggested by Qualcomm.

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**COMMENTS OF  
THE WIRELESS INTERNET SERVICE PROVIDERS ASSOCIATION**

The Wireless Internet Service Providers Association (“WISPA”), pursuant to Sections 1.415 and 1.419 of the Commission’s Rules,<sup>1</sup> hereby responds to the Notice of Proposed Rulemaking (“*NPRM*”) in the above-captioned proceeding,<sup>2</sup> which seeks comment on contemplated changes to the established Priority Access License (“PAL”) rules and other aspects of the Citizens Broadband Radio Service (“CBRS”).<sup>3</sup>

WISPA strongly opposes changes to the CBRS rules adopted in 2015 that would increase the size of PAL areas, significantly lengthen the term of PAL licenses and permit PAL licenses to be renewed in perpetuity, and urges the Commission to swiftly reject these contemplated changes. Individually and collectively, these changes would effectively foreclose small broadband providers from participating in PAL spectrum auctions, thereby depriving millions of rural Americans that lack access to fixed broadband service of the best and most expeditious means by which they can obtain affordable access to high-quality broadband service in their

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<sup>1</sup> 47 C.F.R. §§ 1.415 and 1.419.

<sup>2</sup> *Promoting Investment in the 3550-3700 MHz Band; Petitions for Rulemaking Regarding the Citizens Broadband Radio Service*, Notice of Proposed Rulemaking and Order Terminating Petitions, 32 FCC Rcd 8071 (2017) (“*NPRM*”). See also 82 Fed. Reg. 56193 (Nov. 28, 2017).

<sup>3</sup> In addition to the subject Comments, WISPA is submitting separate Comments regarding the deficient Initial Regulatory Flexibility Analysis (“*IRFA*”), which is Appendix B to the *NPRM*.

homes. This is no way to help bridge the digital divide – rather, it is a sharp stick in the eye emanating from mobile wireless interests that incorrectly insist that America’s leadership in “5G” is somehow threatened if PALs are not made available for any purpose other than one tailor-made to their specifications.

In connection with these Comments, WISPA surveyed its members.<sup>4</sup> More than 63 percent of survey respondents reported that they have invested and deployed broadband service in reliance on the rules that have been in place for the past two-and-a-half years.<sup>5</sup> These private capital investments are primarily capital and operating expenses associated with deploying software-defined LTE-based equipment to launch new service in the 3650-3700 MHz band. Notably, this equipment can be software-upgraded to operate in the 3550-3700 MHz band in a manner that does not require the operator to purchase any additional hardware or incur the expense of additional truck rolls to replace customer premise equipment (“CPE”). Perhaps more significantly, the survey results also show that 60 percent of respondents have already reduced their investment or curtailed deployment based on the threat presented by the contemplated changes to the PAL licensing rules.<sup>6</sup> This demonstrates that WISPs highly value PALs and are not satisfied with being confined to sharing a limited amount of General Authorized Access (“GAA”) spectrum.

WISPA also rejects the assertion that allowing partitioning and disaggregation of PALs is a remedy for problems that result from increasing PAL area size. Here again, WISPA’s survey results demonstrate that its members overwhelmingly are not able to acquire licensed spectrum on the secondary market from the large carriers that have assembled large spectrum holdings covering large areas. Fewer than ten percent of members that tried to gain access to licensed

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<sup>4</sup> WISPA’s survey results are shown in Appendix A hereto.

<sup>5</sup> See Appendix A at A-1.

<sup>6</sup> See *id.* at A-2.

spectrum from the large carriers were successful. Build-out requirements are not an adequate substitute for larger PAL areas and longer PAL terms. They are fundamentally inconsistent with the “use-it-or-share-it” regime for the band, in that they will create incentives for PAL holders to engage in nominal deployments that occupy spectrum in a manner that offers little commercial benefit or does not actually connect end users.

WISPA also opposes eliminating the transparency requirements in Section 96.55(a)(3). However, WISPA agrees that the Commission should relax the out-of-channel emission standards for channel sizes that are larger than 10 megahertz.

The outcome of this proceeding need not be the zero-sum result that would hand over the licensed band to a few global companies that claim a need for large-area, long-term licenses that are tailor-made for a particular business model that only they can exploit, leaving all others to crowd into the remaining GAA spectrum. To the contrary, retaining the existing rules will, in the words of Commissioner Carr, “incentivize a wide variety of use cases and deployments”<sup>7</sup> by enabling both applications for *capacity* in densely populated areas and a wide variety of diverse and innovative services that require spectrum *coverage* in areas that are less densely populated. In so doing, the Commission will avoid “adopt[ing] artificial restrictions through license and auction structure to dissuade some uses or users while promoting others”<sup>8</sup> and avoid “picking winners and losers.”<sup>9</sup>

The better solution is to stay the course. As stated in a concurrently filed economic analysis submitted by MIT research scientist Dr. William Lehr:

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<sup>7</sup> *NPRM* at 8112, Statement of Commissioner Brendan Carr (“Carr Statement”).

<sup>8</sup> *Id.* at 8111, Statement of Commissioner Michael O’Rielly (“O’Rielly Statement”).

<sup>9</sup> *Restoring Internet Freedom*, WC Docket No. 17-108, Oral Statement of Chairman Ajit Pai (Dec. 14, 2017) (“Pai RIF Statement”), at 4 (“What I *am* saying is that the government shouldn’t be in the business of picking winners and losers in the Internet economy”) (emphasis in original).

By designing a level playing field open to participation by all types of potential CBRS users and by not seeking to pre-determine which types of business models and uses should be favored in the licensing framework, the original CBRS design makes spectrum management more responsive and dynamically flexible to adapt to changing technology and market conditions.<sup>10</sup>

## Introduction

WISPA has been an active participant in the proceedings leading to adoption of the CBRS rules<sup>11</sup> and the *NPRM*.<sup>12</sup> Even before the initial docket opened in 2012 and before the President's Council of Advisors on Science and Technology issued its influential spectrum-sharing report,<sup>13</sup> WISPA urged the Commission to propose rules for the 3550-3650 MHz band that would permit sharing among federal and commercial fixed wireless users.<sup>14</sup> WISPA's

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<sup>10</sup> William Lehr, *Analysis of Proposed Modifications to CBRS PAL Framework*, GN Docket No. 17-258 (filed Dec. 28, 2017) ("Lehr Analysis"), at 8. As noted therein, WISPA is one of supporters of the Lehr Analysis. The Commission may recall that Dr. Lehr is a proponent of "right-sizing" geographic areas for spectrum auctions. See Letter from Steven K. Berry, President and CEO, Competitive Carriers Association, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-268 (filed Nov. 20, 2013), with attachment, William Lehr & J. Armand Musey, *Right-Sizing Spectrum Auction Licenses: The Case for Smaller Geographic License Areas in the TV Broadcast Incentive Auction*.

<sup>11</sup> See *Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, 30 FCC Rcd 3959 (2015) ("CBRS Order"); *Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, 31 FCC Rcd 5011 (2016) ("CBRS Recon Order").

<sup>12</sup> See Comments of WISPA, GN Docket No. 12-354 (filed July 24, 2017) ("WISPA 2017 Comments"); Reply Comments of WISPA, GN Docket No. 12-354 (filed Aug. 8, 2017); Letter from Stephen E. Coran, Counsel to WISPA, to Marlene H. Dortch, GN Docket Nos. 17-258 and 17-183 (filed Oct. 19, 2017) (summarizing ex parte presentation with Commissioner O'Rielly); Letter from Stephen E. Coran, Counsel to WISPA, to Marlene H. Dortch, GN Docket No. 17-258 (filed Oct. 17, 2017) (summarizing ex parte presentation with Commissioner Clyburn's legal advisor); Letter from Stephen E. Coran, Counsel to WISPA, to Marlene H. Dortch, GN Docket No. 17-258 (filed Dec. 6, 2017) (summarizing ex parte presentation with Chairman Pai).

<sup>13</sup> See President's Council of Advisors on Science and Technology, Report to the President: Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth (rel. July 20, 2012), available at [http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast\\_spectrum\\_report\\_final\\_july\\_20\\_2012.pdf](http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_spectrum_report_final_july_20_2012.pdf).

<sup>14</sup> See WISPA Comments, ET Docket No. 10-123 (filed Apr. 22, 2011). Notably, CTIA recommended that the Commission focus on spectrum below 3 GHz because spectrum above 3 GHz was not then deemed to be useful for mobile broadband. See Comments of CTIA – The Wireless Association, ET Docket No. 10-123 (filed Apr. 22, 2011), at 13. *No party advocated for a mobile allocation in the 3550-3650 MHz band at that time.* See Comments of AT&T, ET Docket No. 10-123 (filed Apr. 22, 2011), at 7 (because "this band would also likely be allocated over a non-nationwide footprint . . . whether providers of mobile broadband services would be able to effectively offer mobile services in these bands is subject

advocacy focused on three critical objectives to ensure that the 3550-3700 MHz band could be used for fixed wireless broadband services: (1) the ability of 3650-3700 MHz licensees to continue to deploy service to consumers, businesses and first responders, (2) rules providing a meaningful opportunity for WISPs to access CBRS spectrum on both a Priority Access and GAA basis, and (3) grandfathered protection rights for existing 3650-3700 MHz band users and assurance that investment would not be stranded.<sup>15</sup>

The Commission achieved these objectives in the *CBRS Order*. First, at the urging of then-Commissioner Pai, the Commission permitted existing 3650-3700 MHz Service licensees to continue to register locations to deploy expanded service to the public. As then-Commissioner Pai stated, “the *Order* now ensures that existing wireless Internet service providers can continue to deploy broadband to rural consumers rather than freezing them out during the transition to a new 3.5 GHz regime.”<sup>16</sup> As discussed *infra*, WISPs have invested significant private, at-risk capital deploying in reliance on this decision, and thousands more consumers now are receiving affordable (and unsubsidized) fixed broadband service in their homes and businesses. Second, the Commission adopted census tracts as the geographic unit for PALs, allocated spectrum for GAA on a “license by rule” basis and established three-year PAL terms with opportunistic GAA use when and where PALs are not active, thereby promoting efficient and timely spectrum

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to question. . . . Still, we believe that given the substantial areas covered by exclusion zones, the most likely deployments would be fixed, rather than mobile”); Comments of T-Mobile, ET Docket No. 10-123 (filed Apr. 22, 2011), at 7 (“the spectral location of the 3550-3650 MHz, 4200-4220 MHz and 4380-4400 MHz bands make them less suitable for mobile broadband applications”).

<sup>15</sup> See, e.g., WISPA Comments, GN Docket No. 12-354 (filed Feb. 20, 2013); WISPA Reply Comments, GN Docket No. 12-354 (filed Apr. 5, 2013); WISPA Comments, GN Docket No. 12-354 (filed Dec. 5, 2013); WISPA Reply Comments, GN Docket No. 12-354 (filed Dec. 20, 2013); WISPA Comments, GN Docket No. 12-354 (filed July 14, 2014); WISPA Reply Comments, GN Docket No. 12-354 (filed Aug. 15, 2014); WISPA Reply Comments, GN Docket No. 12-354 (filed Jan. 12, 2016). WISPA also has submitted approximately 20 ex parte letters and also joined 16 other parties in an ex parte letter submitted on June 1, 2017. See Letter from All Points Broadband *et al.* to The Honorable Ajit Pai *et al.*, GN Docket No. 12-354 (filed June 1, 2017).

<sup>16</sup> *CBRS Order* at 4142, Statement of Commissioner Ajit Pai Approving in Part and Concurring in Part.



utilization. Third, the Commission established transition and grandfathering procedures that ensure protection of existing facilities that are “in use,” recognizing that consumers would be harmed if existing services were disrupted.<sup>17</sup> Taken together, these policy decisions create a framework that reduces barriers to entry and enables participation by small, rural entities whose business models would not enable them to offer competitive bids if PALs cover geographic areas that are many times larger than the area where they would deploy in CBRS spectrum, or if the term of the license (especially if there is an expectation of renewal) is excessively long.

In the two-and-a-half years since the Commission unanimously adopted the *CBRS Order*, stakeholders have worked hard to bring the promise of the CBRS band to commercial fruition. The Wireless Innovation Forum (“WInnForum”), which includes WISPA as an active member, has made substantial progress in the development of policies and protocols for the Spectrum Access System (“SAS”) and the Environmental Sensing Capability (“ESC”) that will protect military incumbents. The CBRS Alliance, now more than 70 strong, is focusing on the development of LTE technologies and use cases.<sup>18</sup> The Commission has granted dozens of experimental licenses that will yield important technical and market information for a wide variety of use cases – rural broadband, neutral host networks, venues and Industrial Internet of Things (“IIoT”), to name but a few.

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<sup>17</sup> See *Public Notice*, “Wireless Telecommunications Bureau and Office of Engineering and Technology Announce Methodology for Determining the Protected Contours for Grandfathered 3650-3700 MHz Band Licensees, GN Docket No. 12-354, DA 16-946 (rel. Aug. 19, 2016); *Public Notice*, “Wireless Telecommunications Bureau Announces Filing Window and Procedures for 3650-3700 MHz Band Licensees to File Supplemental Information Necessary for Creating Grandfathered Wireless Protection Zones,” GN Docket No. 12-354, DA 17-340 (rel. Apr. 7, 2017).

<sup>18</sup> WISPA and the CBRS Alliance have entered into an agreement by which they will work together to accelerate the commercialization of the CBRS band. See Press Release, “WISPA and CBRS Alliance Enter Cooperation Agreement to Advance Commercialization of the CBRS ‘Innovation Band,’” available at <http://www.marketwired.com/press-release/wispa-cbrs-alliance-enter-cooperation-agreement-advance-commercialization-35-ghz-2240864.htm> (last visited Dec. 9, 2017).

However, just as technical standard development, investment and innovation were gaining momentum, CTIA and T-Mobile USA, Inc. filed petitions for rulemaking proposing fundamental changes to the PAL rules.<sup>19</sup> Notwithstanding vigorous opposition from WISPA,<sup>20</sup> dozens of WISPs<sup>21</sup> and numerous other spectrum-based service providers, equipment manufacturers, and others interested in the development of the band – indeed, *everyone* except the mobile wireless carriers, their trade associations and equipment suppliers – the Commission adopted the *NPRM* over the dissent of Commissioner Rosenworcel<sup>22</sup> and with the concurrence of Commissioner Clyburn.<sup>23</sup> In offering his perspective, Commissioner Carr aptly stated that “the 3.5 GHz band is about creating something different. . . . We need a new tool in the spectrum tool kit, and the 3.5 GHz band presents us with that opportunity.”<sup>24</sup> Commissioner O’Rielly pledged to “keep an open mind,”<sup>25</sup> consistent with his “fervent[] belie[f] that this spectrum should be available for all purposes, and, yes, that includes 5G. What the Commission won’t do here is adopt artificial restrictions through license and auction structure to dissuade some uses while promoting others.”<sup>26</sup>

The *NPRM* proposes to adopt those aspects of the Petitions that would extend license terms of ten years and allow some form of license renewability, and seeks comment on whether

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<sup>19</sup> See CTIA Petition for Rulemaking, GN Docket No. 12-354 (filed June 16, 2017) (“CTIA Petition”); T-Mobile Petition for Rulemaking, GN Docket No. 12-354 (filed June 19, 2017) (“T-Mobile Petition”) (collectively, “Petitions”).

<sup>20</sup> See n.12, *supra*.

<sup>21</sup> A list of these commenters and a map showing their base of operations is attached hereto as Appendix B.

<sup>22</sup> *NPRM* at 8113, Statement of Commissioner Jessica Rosenworcel, Dissenting (“Rosenworcel Dissent”) (“this rulemaking seeks to gut what was most visionary about this framework”).

<sup>23</sup> *Id.* at 8108, Concurring Statement of Commissioner Mignon L. Clyburn (“Clyburn Statement”) (“The overwhelming evidence demonstrates that these rules are working”).

<sup>24</sup> Carr Statement at 8112.

<sup>25</sup> O’Rielly Statement at 8111.

<sup>26</sup> *Id.* at 8110-11.

to adopt larger geographic areas for PALs.<sup>27</sup> The *NPRM* also seeks comment on whether to amend rules regarding (1) secondary markets for PALs, (2) public disclosure requirements for the SAS, (3) competitive bidding procedures to allow the assignment of PALs even when there is only one applicant for a given license, and (4) out-of-channel emissions limits. Noting the lack of any support and significant opposition, the *NPRM* correctly denied those aspects of the T-Mobile Petition that sought to designate the entire 3550-3700 MHz band for PAL use and to limit GAA to opportunistic use.<sup>28</sup>

### **Discussion**

In adopting the *NPRM*, the Commission majority has sent a message to rural Americans without access to residential broadband today that their needs could remain unmet because a handful of large mobile wireless carriers desire additional licensed spectrum to facilitate future prospective increases in capacity in higher density areas. The Commission's adoption of the *NPRM* is unsupported by the record developed in consideration of the Petitions, and WISPA's survey results demonstrate that the threat of changes to the PAL rules is already chilling innovation, investment and deployment.

In particular, the Commission is considering two damaging fundamental changes to the PAL licensing rules. First, the Commission proposes to extend PAL license terms from three years to ten years, a term identical to other, traditional wireless licenses issued by the Commission. Second, the Commission proposes to eliminate the requirement that licenses terminate automatically at the end of the license term, which would essentially create perpetual, renewable licenses, which again would be identical to the existing licensing scheme for most

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<sup>27</sup> See *id.* at 8074-81 (¶¶ 9-27).

<sup>28</sup> See *id.* at 8092-93 (¶ 60). The Commission also denied T-Mobile's request to increase CBSD power limits. See *id.* at 8093-94 (¶ 61). WISPA commends the Commission for disposing of these arguments so that they do not inject further uncertainty into this proceeding.

other wireless services. In addition to these proposals, the Commission also seeks comment on the most harmful potential change to the PAL rules – whether to increase the geographic license area of PALs, which would make these licenses more closely mirror existing “command and control” Commission licenses, in this case those already issued to the dominant mobile wireless carriers.

The mobile industry may assert that its proposals are “limited”<sup>29</sup> and not “fundamental,”<sup>30</sup> and the *NPRM* may characterize the proposed changes as “targeted.”<sup>31</sup> But these terse words are of little solace to the millions of rural Americans that are in the crosshairs of the mobile wireless industry and enabled by a Commission that, despite the record, seems to not appreciate the mobile carriers’ efforts for what they are – a spectrum grab that will convert a band where innovation, investment and deployment is beginning to flourish into a “same old, same old” command and control band for a select few established wireless carriers.

**I. IF ADOPTED, THE COMMISSION’S CONTEMPLATED REVISIONS TO THE PRIORITY ACCESS LICENSING SCHEME WOULD BROADEN THE DIGITAL DIVIDE AND STRAND INVESTMENTS ALREADY MADE IN RELIANCE ON THE 2015 RULES**

The contemplated changes to the PAL licensing rules should be swiftly rejected, as they would create a new kind of divide between the “spectrum haves” and the “spectrum have-nots.” Mobile interests would undoubtedly increase their already vast holdings of licensed spectrum for urban capacity, while other use cases would be relegated to only second-tier, “license by rule” GAA spectrum. By contrast, the current rules enable the 5G use case that mobile interests desire

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<sup>29</sup> Letter from Scott K. Bergmann, Vice President, Regulatory Affairs, CTIA, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354, *et al.* (filed Oct. 12, 2017), at 1.

<sup>30</sup> Reply Comments of T-Mobile, GN Docket No. 12-354, RM-11788 & RM-11789 (filed Aug. 8, 2017), at 6.

<sup>31</sup> *NPRM* at 8072 (¶ 3).

and also easily accommodate other use cases that will promote consumer welfare. As Dr. Lehr concludes:

Small license areas allow both users with geographically-localized, specially-contoured usage profiles and users with wide-area access needs to efficiently match acquired spectrum to their particular needs. The former may be interested in only a small amount of spectrum in one or a few areas, while the latter can acquire multiple licenses in multiple areas. Larger license areas effectively preclude a large number of companies from participating in the auction or using the spectrum. This is likely to reduce efficiency and the overall value produced by the band.<sup>32</sup>

The Commission should not guarantee the zero-sum outcome inherent in changing the PAL licensing rules. Accordingly, the Commission should reject its proposed change to the PAL license term, limit license renewability and, most importantly, retain census tracts as the PAL geographic unit.

**A. If Adopted, The Contemplated Licensing Rules Will Undermine Efforts To Bridge The Digital Divide**

**1. Rural Americans Continue To Lack Access To Fixed Broadband Service And Competitive Choice**

Recent Commission reports confirm the lack of fixed broadband availability and consumer choice in rural areas. According to the Commission's *2016 Broadband Progress Report*, five percent of rural Americans lack access to fixed broadband service at even 4/1 Mbps, six percent lack access to 10/1 Mbps service, and 39 percent (23 million people) lack access to 25/3 Mbps service.<sup>33</sup> Where broadband is available to rural Americans, competition is generally lacking – 48 percent have access to one provider and only 13 percent have access to more than one provider.<sup>34</sup> Only 42 percent of developed census blocks in the U.S. have access to more than

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<sup>32</sup> Lehr Analysis at 11.

<sup>33</sup> *2016 Broadband Progress Report*, 31 FCC Rcd 699, 731-32 (2016). See also *id.* at 738, n.261 (average land area of census tracts without 25/3 Mbps access is 84.8 square miles compared to 5.9 square miles for census tracts with access).

<sup>34</sup> See *id.* at 736, Table 6.

one provider offering fixed broadband speeds of at least 25/3 Mbps, and only 12 percent of developed census blocks in the U.S. have access to more than one provider offering fixed broadband speeds of at least 100 /10 Mbps.<sup>35</sup>

The *2016 Broadband Progress Report* also found a correlation between broadband access and household income, concluding that “[o]n average, the proportion of the population without access is highest in counties with the lowest median household population, the lowest population density, the highest rural population and the highest poverty rate.”<sup>36</sup> It is likely that consumers in rural areas will be less able to afford residential broadband service than their urban counterparts. According to the U.S. Department of Agriculture, 85.3 percent of persistent poverty counties – those that have consistently had high poverty rates over the last 30 years – are in nonmetro areas.<sup>37</sup> As Chairman Pai has stated, “[i]n urban areas 98% of Americans have access to high-speed fixed service. In rural areas, it’s only 72%. 93% of Americans earning more than \$75,000 have home broadband service, compared to only 53% of those making less than \$30,000.”<sup>38</sup>

Chairman Pai summed it up this way:

If you live in rural America, you are much less likely to have high-speed Internet service than if you live in a city. If you live in a low-income neighborhood, you are less likely to have high-speed Internet access than if you live in a wealthier area. The digital divide in our country is real and persistent.<sup>39</sup>

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<sup>35</sup> See “Internet Access Services: Status as of June 30, 2016,” Industry Analysis and Technology Division, Wireline Competition Bureau (April 2017) (“*2017 Internet Access Report*”), at Fig. 4. Figure 4 shows that 58 percent of developed census blocks have access to one or fewer service providers offering broadband speeds of 25/3 Mbps and 88 percent of developed census blocks have access to one or fewer service providers offering broadband speeds of 100/10 Mbps. Further, Figure 4 *overstates* the level of competition because “a provider that reports offering service in a particular census block may not offer service, or service at that speed, to all locations in the census block.” *Id.* at 6.

<sup>36</sup> See *2016 Broadband Progress Report* at 740 (footnote omitted).

<sup>37</sup> The United States Department of Agriculture, Geography of Poverty, March 1, 2017, [available at https://www.ers.usda.gov/topics/rural-economy-population/rural-poverty-well-being/geography-of-poverty/](https://www.ers.usda.gov/topics/rural-economy-population/rural-poverty-well-being/geography-of-poverty/) (last visited July 15, 2017).

<sup>38</sup> Remarks of FCC Chairman Ajit Pai at “Broadband for All” Seminar, Stockholm, Sweden, June 26, 2017, at 1.

<sup>39</sup> Remarks of FCC Chairman Ajit Pai at the American Enterprise Institute, *The First 100 Days: Bringing the Benefits of the Digital Age to All Americans*, May 5, 2017, at 2.

Beyond the statistics and probabilities lie the real effects of a lack of fixed broadband access. A recent article from *The Post and Courier*, the Pulitzer Prize-winning daily newspaper in Charleston, South Carolina, reported that, in the six-county Low Country Promise Zone, “[t]wo in five residents can’t buy broadband Internet because the infrastructure doesn’t exist.”<sup>40</sup> The article continues that leaving tens of thousands of people without broadband access “will have lasting effects that could leave the region behind. They see a problem with implications for their residents’ health, education and economic opportunity. Their concerns echo through rural corners of the country from coast to coast.”<sup>41</sup>

It cannot be disputed that there is a persistent digital divide in this country, that rural Americans are on the wrong side of that divide and that disconnection from the digital economy can have profound economic and social effects. Access to spectrum for fixed broadband service is an essential tool for bridging that gap.

## **2. Spectrum Is Affordable Infrastructure For Fixed Broadband Service**

In many areas of our country, consumers can obtain access to fixed broadband service only through a WISP. A primary reason is that wired technologies such as fiber-to-the-home (“FTTH”) and cable broadband cannot be cost-effectively deployed in areas with low population density.<sup>42</sup> The *Wall Street Journal* reported this past Summer that “[r]ural America can’t seem to

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<sup>40</sup> Thad Moore, *Half of South Carolina’s rural ‘Promise Zone’ doesn’t have Internet access. It has a plan to get it.*, THE POST AND COURIER, Dec. 2, 2017, available at [https://www.postandcourier.com/business/half-of-south-carolina-s-rural-promise-zone-doesn-t/article\\_df05ac94-d624-11e7-b069-6fc7654c4377.html](https://www.postandcourier.com/business/half-of-south-carolina-s-rural-promise-zone-doesn-t/article_df05ac94-d624-11e7-b069-6fc7654c4377.html) (last visited Dec. 4, 2017) (“Post and Courier Article”).

<sup>41</sup> *Id.*

<sup>42</sup> See, e.g., Daisuke Wakabayashi, *Google Curbs Expansion of Fiber Optic Network, Cutting Jobs*, N. Y. TIMES, Oct. 25, 2016, available at [https://www.nytimes.com/2016/10/26/technology/google-curbs-expansion-of-fiber-optic-network-cutting-jobs.html?\\_r=0](https://www.nytimes.com/2016/10/26/technology/google-curbs-expansion-of-fiber-optic-network-cutting-jobs.html?_r=0) (last visited July 14, 2017) (“In June [2016], Google Fiber announced that it was acquiring Webpass, a company that beams high-speed internet into apartment buildings using a fiber-connected antenna. This and other wireless technologies provide a quicker and less expensive way to expand access to faster web speeds”). See also Hal Singer, *Assessing*

afford broadband: Too few customers are spread over too great a distance. The gold standard is fiber-optic service, but rural internet providers say they can't invest in door-to-door connections with such a limited number of subscribers.”<sup>43</sup> According to a recent report prepared by The Carmel Group, fixed wireless broadband access can be deployed at one-seventh the capital expense of FTTH and about one-fourth the capital expense of cable broadband.<sup>44</sup> Quoting a study prepared by consulting firm Wireless 20/20, RCRWireless reported that “fixed wireless could reduce capital expenditures by more than 50% for many low-density CAF II funded high-cost rural broadband deployments.”<sup>45</sup> As Rise Broadband's Jeff Kohler explained, “[t]he economics of the [fixed wireless broadband] business are very favorable. The reason they are is because it costs somewhere between a fifth to a tenth of the cost of building a traditional wireline network, be it cable or fiber.”<sup>46</sup> In the Low Country Promise Zone, local governments are mapping water tanks to enable fixed wireless broadband – as The Post and Courier states, “[f]rom the right vantage point, telecom companies could beam Internet service to homes miles away, rather than lay fiber. The idea is to take a page from satellite Internet, but with broadband beamed from water towers instead of space.”<sup>47</sup> It is not surprising that the Lehr Analysis, relying

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*the Impact of Removing Regulatory Barriers on Next Generation Wireless and Wireline Broadband Infrastructure Investment*, (June 2017), at 32 (estimating that, even if infrastructure barriers are removed, only 71 percent of the nation's premises will be economically viable for fiber).

<sup>43</sup> Jennifer Levitz and Valerie Bauerlein, *Rural America is Stranded in the Dial-Up Age*, WALL ST. J., June 16, 2017, at A1. The article estimates that it costs \$30,000 per mile to install optical fiber.

<sup>44</sup> See The Carmel Group, *Ready for Takeoff: Broadband Wireless Access Providers Prepare to Soar with Fixed Wireless*, (2017) (“Carmel Report”), at 12, Fig. 6. A copy of the Carmel Report is attached hereto as [Appendix C](#).

<sup>45</sup> Berge Ayvazian, *Analyst Angle: 4G LTE leveraged for fixed wireless broadband in rural communities*, RCRWIRELESS, June 6, 2017, available at <http://www.rcrwireless.com/20170606/analyst-angle/20170606wireless4g-lte-leveraged-for-fixed-wireless-broadband-in-rural-communities-tag10> (last visited June 27, 2017).

<sup>46</sup> See Mike Dano, *Top 10 ISPs to watch: From C Spire to Redzone to Sonic*, FIERCE TELECOM, June 26, 2017, available at <http://www.fiercetelecom.com/special-report/top-10-isps-to-watch-from-c-spire-to-redzone-to-sonic> (last visited July 14, 2017).

<sup>47</sup> Post and Courier Article. Many WISPs rely on vertical infrastructure such as water tanks and grain silos, in addition to traditional communications towers.



on studies performed by others, concluded that “using fixed wireless instead of wired broadband to solve our rural broadband problem could save the U.S. economy upwards of \$30 billion to \$60 billion in investment.”<sup>48</sup>

Fixed wireless technology is the most cost-effective last-mile solution in many unserved areas, and mid-band spectrum is the best platform for offering non-line-of-sight capability. The CBRS band, and PALs in particular, offer a new and immediate opportunity for WISPs to invest in network upgrades that can expand the availability and sustainability of affordable broadband access to consumers in areas that are currently underserved. The Commission thus should not change the rules in a way that would deprive those most likely to deploy service to rural Americans from achieving that objective.

**B. If Adopted, The Contemplated Licensing Rules Will Destroy Investment, Innovation And Deployment Made In Reliance On The Rules Adopted In 2015**

**1. There Has Been Significant Investment, Innovation And Deployment Made In Reliance On The Rules Adopted In 2015**

In the *CBRS Order*, the Commission made clear that its rules were intended to accommodate a number of different use cases, including rural broadband access:

This regulatory adaptability should make the 3.5 GHz Band hospitable to a wide variety of users, deployment models, and business cases, including some solutions to market needs not adequately served by our conventional licensed or unlicensed rules. Carriers can avail themselves of “success-based” license acquisition, deploying small cells on a GAA basis where they need additional capacity and paying for the surety of license protection only in targeted locations where they find a demonstrable need for more interference protection. Real estate owners can deploy neutral host systems in high-traffic venues, allowing for cost-effective network sharing among multiple wireless providers and their customers. Manufacturers, utilities, and other large industries can construct private wireless broadband networks to automate processes that require some measure of interference protection and yet are not appropriately outsourced to a commercial cellular network. *Smart grid, rural broadband, small cell backhaul, and other*

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<sup>48</sup> Lehr Analysis at 20-21.

*point-to-multipoint networks can potentially access three times more bandwidth than was available under our previous 3650-3700 MHz band rules.*<sup>49</sup>

The WISP industry's interest in the band is manifest not just in WISPA's long-term advocacy, but in its members' deployments in the 3650-3700 MHz band and the numerous experimental operations underway in the 3550-3650 MHz band. Based on a recent review of the Commission's Universal Licensing System ("ULS"), since the Commission began accepting applications for nationwide non-exclusive 3650-3700 MHz Service licenses in November 2007, the Commission has granted more than 2,770 regular licenses that remain in active status and has registered more than 63,200 locations. Provided with the opportunity created and encouraged by the *CBRS Order* to continue to deploy fixed broadband service to consumers in the 3650-3700 MHz band, WISPs have done exactly that. Since April 18, 2015 – the day after the Commission froze the issuance of new licenses in the band – the Commission has registered more than 19,000 locations, none of which is even eligible for grandfathered interference protection.<sup>50</sup> Licensees

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<sup>49</sup> *CBRS Order* at 3962 (emphasis added). See also Lehr Analysis at 6 (“[t]his framework recognizes that, unlike in the past, today’s wireless marketplace includes a far more diverse set of companies that require access to licensed and unlicensed spectrum to support a far larger number of business operations”).

<sup>50</sup> See 47 C.F.R. § 90.1307(b) (prohibiting Commission from granting new licenses or license renewals after April 17, 2015, with limited exceptions).

include rural WISPs,<sup>51</sup> enterprise broadband providers,<sup>52</sup> energy companies,<sup>53</sup> municipalities and government agencies,<sup>54</sup> telecommunications cooperatives,<sup>55</sup> private networks<sup>56</sup> and resorts.<sup>57</sup>

WISPA recently surveyed its operator members to better quantify the extent of the industry's investments and deployments made in reliance on the rules adopted in the *CBRS Order*. Nearly two-thirds of the respondents to that survey – 63 percent – are making use of this spectrum today to provide service to their customers, with several having made considerable capital investments to procure and deploy equipment in this band.<sup>58</sup> One operator reported that it had spent two million dollars in equipment costs and a number of others reported capital expenditures of several hundred thousand dollars. For small WISPs – most WISPs have 10

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<sup>51</sup> Examples include Sacred Wind Communications, Inc. (Call Sign WQII541) with at least 760 locations (many that are on or near Tribal lands), Kansas Broadband Internet, Inc. (Call Sign WQHV739) with 35 registered locations, Bug Tussel Wireless LLC (Call Sign WQIB703) with 54 locations, and Softcom Internet Communications, Inc. (Call Sign WQIG223) with 815 locations.

<sup>52</sup> For example, BOB, LLC dba Business Only Broadband (Call Sign WQIF263) has 54 registered locations at buildings in the Chicago and Milwaukee areas. KGT, LLC (Call Sign WQHV407) has 17 registered locations and serves businesses in the Phoenix area.

<sup>53</sup> Chevron USA Inc. (Call Sign WQHV404) was one of the first licensees in the band. It has registered more than 615 locations. San Diego Gas & Electric (Call Sign WQJD279) has 49 registered locations. ConocoPhillips Communications Inc. (Call Sign WQJC317) has two registered locations. RigNet Satcom, Inc. (Call Sign WQIQ622) has 13 registered locations and provides services to oil rigs in the Gulf of Mexico.

<sup>54</sup> Examples include the City of Houston, Texas (Call Sign WQJC308) with 1707 registered locations and the Utah Department of Transportation (Call Sign WQKL878) with 12 registered locations.

<sup>55</sup> Examples include Farmers Telecommunications Cooperative, Inc. (Call Sign WQID246), a rural cooperative based in Rainsville, Alabama, with registered 15 locations, Red River Telephone Association (Call Sign WQII527), based in Abercrombie, North Dakota, with 28 locations and Gardonville Cooperative Telephone Association (Call Sign WQID890), based in Brandon, Minnesota, with 33 registered locations.

<sup>56</sup> For example, NASCAR (Call Sign WQJJ961) has 30 registered locations at race tracks around the country.

<sup>57</sup> Resort Broadband, Inc. (Call Sign WQHV745) has registered 67 locations in the Steamboat Springs, Colorado area. ResortNet, LLC (Call Sign WQJC428) has four registered locations at Keystone and Breckinridge, Colorado.

<sup>58</sup> See [Appendix A](#) at A-1.

employees or fewer – that serve mostly small, rural communities, these investments represent a significant percentage of their overall budgets.<sup>59</sup>

The statistics derived from the survey do not tell the whole story. Highspeedlink.net, a WISP in rural Virginia, explained that “[t]his band has been part of our long term planning to continue to cost effectively serve our community as well as grow our business. Access to this spectrum both in the GAA form as well as PAL will allow us to not only grow our investments even more so but will allow us to move into a more secure spectrum space that will allow our company to offer more services.”<sup>60</sup> Kentucky-based WISP Fastnet Wireless reported that “[o]nce CBRS is complete we plan on making a huge overlay of our existing network to give even more speeds to existing customers and enhancing coverage to leave nobody unserved.”<sup>61</sup> Similar to other submissions in the record, Joink, LLC, stated that “many small operators, like Joink, have already invested in and deployed equipment capable of utilizing the CBRS band...

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<sup>59</sup> Such investments are very important, as many small providers reduced overall investment given the uncertainties presented by Title II regulation.

<sup>60</sup> Letter from Alex Phillips, CEO, Rural Broadband Network Service LLC dba Highspeedlink.net, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 21, 2017) at 1. *See also* Letter from Jay Domingue, Business Development, Gonthier, Inc. dba REACH4 Communications, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 18, 2017) (“Reach4 Letter”) (“REACH4 Communications is eager to access additional spectrum in the CBRS band. Because there is more spectrum, we will be able to increase data capacity and offer even higher speeds to our customers. This means more investment in equipment and the ability to reach even more potential customers that still do not have broadband speeds”); Letter from James Bouse, Owner, Brazos WiFi, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 24, 2017) (“All of our new tower sites are being outfitted with LTE systems with the expectation that the CBRS band will allow us to better service those folks which are hard to reach”); Letter from TecInfo Communications, LLC, GN Docket No. 12-354 (filed July 24, 2017), at 3 (“Additional investment has been made, testing equipment operating at 3.65-3700MHZ utilizing the CBRS band. TecInfo Communications, along with many industry peers are prepared to continue investing into network expansion, reaching many more unserved rural Americans”).

<sup>61</sup> Letter from Mike Calvin, Fastnet Wireless LLC, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 24, 2017), at 1. *See also* Letter from Mike Boley, President and CEO, Wabash Communications, Inc., to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 24, 2017) (“Wabash Letter”), at 2 (“As a small fixed wireless provider in rural Ohio we have invested heavily in equipment operating in the 3650-3700 GHz and are currently adding equipment upgrades to provide faster rural internet service”); Reach4 Letter (“In the last 3 years, REACH4 Communications has invested heavily in 3650-3700Mhz radio equipment to upgrade legacy 900Mhz, 2.4GHz, and 5GHz equipment... Because of the 3650-3700MHz band, we can now offer speeds up to 12 Mbps down and 4 Mbps up on our fixed wireless broadband service”).

Approximately half of Joink’s 2017 wireless investment has gone towards CBRS capable equipment and a larger portion is currently planned for Q4 2017 and all of 2018.”<sup>62</sup> Another WISP, BDA Wireless, LLC, a start-up provider in rural Alabama, explained that “[o]ur company has invested thousands in 3650-3700 equipment that is designed to work within all current requirements of CBRS.”<sup>63</sup> Rise Broadband, the country’s largest WISP, reported that it has “spent millions of dollars deploying base stations in the band” and “had every expectation that the rules adopted in 2015 would remain in place.”<sup>64</sup> Rise Broadband explained that some of its investment and deployment is supporting build-out of rural broadband experiments that are funded with millions of dollars of Commission support to deploy broadband service to unserved rural Americans.<sup>65</sup>

What are the drivers of this rapidly increasing use of the 3650-3700 MHz band? First, consumer demand, particularly in otherwise unserved and underserved rural markets, is fueling deployment by fixed wireless broadband providers. In many locations, wireline technologies are simply not cost-efficient to deploy, leaving fixed wireless as the only affordable low-latency solution. Second, licensees are deploying LTE-based and other equipment that can be software

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<sup>62</sup> Letter from Brian Gray, Connectivity Manager, Joink, LLC, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 24, 2017). *See also* Letter from Roland Houin, President, Fourway Computer Products, Inc., GN Docket No. 12-354 (filed July 20, 2017); Letter from Joseph Monroe, Owner, Plains Internet, LLC, GN Docket No. 12-354 (filed July 24, 2017); Letter from Michael Clemons, President, GigaBeam Networks, LLC, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 24, 2017) (“Our current investment in this technology [in the 3650 band] will exceed \$450,000 in this year alone and we have plans to invest up to an additional \$500,000 over the next two years”); Letter from Robert Sullivan, CEO and President, Virginia Broadband, LLC, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 24, 2017) (“Virginia Broadband has also invested heavily in the future of CBRS technology - changing the rules mid-course will have a detrimental impact on our business and our customers”).

<sup>63</sup> Comments of BDA Wireless, LLC, GN Docket No. 12-354 (filed July 24, 2017).

<sup>64</sup> Letter from Jeff Kohler, Co-Founder and Chief Development Officer, Rise Broadband, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 24, 2017), at 1.

<sup>65</sup> *See id.* *See also* Comments of Google Inc. and Alphabet Access in Response to Petitions for Reconsideration, GN Docket No. 12-354, RM-11788 & RM-11789 (filed July 24, 2017) (“Google Comments”), at 8; Comments of Open Technology Institute at New America and Public Knowledge, GN Docket No. 12-354 (filed July 24, 2017) (“OTI/PK Comments”), at 13-14.

updated to incorporate operations in the 3550-3650 MHz band in conjunction with the developing SAS and the ESC. This innovative equipment enables WISPs to increase spectrum capacity from small channels in 3650-3700 MHz to wider channels in 3550-3700 MHz on either a PAL or GAA basis *without purchasing or changing out transmission or end user equipment*. In comments it filed in July 2017, Baicells Technologies reported that “over 1,550 ‘CBRS ready’ LTE base stations have ALREADY been deployed by over 200 predominantly rural broadband operators serving thousands of citizens residing in underserved communities across the USA and we are barely out of the trials stage.”<sup>66</sup> These “CBRS-ready” access points can operate in the 3550-3650 MHz band with a firmware upgrade that avoids the need for new hardware and truck rolls.<sup>67</sup> Third, the superior propagation characteristics of the 3.5 GHz band – well-known to those providers that use the adjacent 3650-3700 MHz band – mean that less vertical infrastructure needs to be deployed to cover sparsely populated areas. Unlike small cells and other applications that require lower power or many access points for network densification, rural broadband providers can deploy on mid-band spectrum to efficiently serve a community from a limited number of access points, reducing capital expenses and ongoing tower lease payments and utility charges. These cost savings are critically important for WISPs, the vast majority of which invest their own private, at-risk capital and do not rely on federal subsidies. Fourth, competition among equipment manufacturers is reducing equipment costs and promoting innovation, for the benefit of licensees and the consumers and applications they serve.

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<sup>66</sup> Comments of Baicells Technologies, GN Docket No. 12-354 (filed July 20, 2017), at 1. Baicells is a member of the MuLTEfire Alliance.

<sup>67</sup> See Letter from Stephen E. Coran, Counsel to Rise Broadband and Baicells Technologies, to Marlene H. Dortch, GN Docket No. 12-354 (filed July 28, 2017), at 2.

In addition, and as both Commissioners Clyburn<sup>68</sup> and Rosenworcel<sup>69</sup> have observed, many entities have applied for and obtained Part 5 experimental licenses to conduct technical and market trials in the 3550-3650 MHz band. The examples listed and summarized in Appendix D hereto illustrate that “significant effort and investment has already occurred for the CBRS band by companies across the communications sector based on the current rules.”<sup>70</sup> As just one example demonstrating the innovation stemming from the 2015 rules, equipment manufacturer Telrad Networks and rural WISP Skywerx Industries used a trial in the 3.5 GHz band to successfully upgrade to a dual sector/dual carrier feature that doubled performance and attained speeds of up to 200 Mbps per sector.”<sup>71</sup> Telrad expects that this feature will be generally available in the first quarter of 2018.

As is readily apparent, industry is responding to the “regulatory adaptability” the Commission established in 2015 as a linchpin of the CBRS band. Ongoing operations in the 3650-3700 MHz band can be easily transitioned for use across the entire 150 megahertz of spectrum for rural broadband deployment, consistent with the Commission’s encouragement for “Grandfathered Wireless Broadband Licensees to procure equipment with an eye toward complying with the Part 96 technical rules once the transition is completed.”<sup>72</sup> Significant innovation has occurred and significant investments have been made in reliance on the CBRS

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<sup>68</sup> See Clyburn Statement at 8108 (noting that “[a]t least a dozen firms have obtained experimental authorizations to trial equipment and technology in the band. They are developing private networks to support an open architecture operating system for the Industrial Internet as well as smart grid, rural broadband, small cell backhaul, and other point-to-multipoint networks”).

<sup>69</sup> See Rosenworcel Dissent at 8114 (“More than 200 experimental authorizations have been granted”). See also O’Rielly Statement at 8111 (“Equipment is being developed, trials are being conducted, and work on the databases continue”).

<sup>70</sup> See Letter from Kalpak Gude, Dynamic Spectrum Alliance President, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 17, 2017).

<sup>71</sup> Press Release, *Skywerx Industries First ISP to Launch Telrad Dual Carrier LTE Solution*, Dec. 6, 2017, available at <http://www.telrad.com/skywerx-industries-first-isp-launch-telrad-dual-carrier-lte-solution/> (last visited Dec. 10, 2011).

<sup>72</sup> *CBRS Order* at 4079.

rules adopted in 2015 as broadband providers prepare to expand their networks and increase throughput by incorporating the 3550-3650 MHz band into their spectrum tool kits. Technology and market trials demonstrate significant investment and innovation for private networks, venues, neutral hosts and a large variety of other use cases.

While it may be true that, “[s]ometimes, too much experimentation can harm and ultimately delay successful deployment of new services”<sup>73</sup> the above discussion makes clear that, in this case, experimentation has been productive, innovation has occurred and successful commercial deployment is at the doorstep.

## **2. Consideration Of Changes To The Proposed Licensing Rules Is Already Chilling Investment, Innovation And Deployment**

The record leading up to the Commission’s adoption of the *NPRM* reflects a disturbing trend – broadband providers are *already* reducing their deployment investment based on the threat presented in the Petitions and now subject to contemplated rules that will, if adopted, make PALs effectively unavailable to small broadband providers. According to Amplex, a WISP in rural Northwest Ohio:

Amplex uses the 3.65 band to provide service to over 1600 customers which will be convert[ed] to CBRS equipment once the ecosystem is available. Amplex has every intention of bidding on PAL’s in our service area and greatly expanding our use of the CBRS band. *Yet over the last several months we have scaled back our investment due to uncertainty over the future of this band.* The current licenses in 3650 expire in less than 4 years, yet the FCC continues to change rules and delay the PAL auctions. Continued investment in a band that we may lose is extremely risky.<sup>74</sup>

Another WISP, Broadband Corp. based in rural Minnesota, explained that “[b]ecause of the potential for the CBRS band to be modified from it [sic] current proposal we now have stopped any further investment in this band until we can be reasonably certain that the CBRS band will

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<sup>73</sup> *Id.* at 4144, Statement of Commissioner Michael O’Rielly Approving in Part and Concurring in Part.

<sup>74</sup> See Letter from Mark Radabaugh, President, Amplex Electric, Inc., to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 24, 2017), at 1 (emphasis added).



be a viable vehicle for our future growth.”<sup>75</sup> Vivint Wireless indicated it will “enthusiastically invest” in PALs based on current rules, but noted that “the requested changes will harm opportunities for fixed-wireless broadband entrants like Vivint and will lock out new competitors.”<sup>76</sup> Southern Linc also noted “the unnecessary delay and uncertainty that these petitions have already created in the opening of the CBRs band.”<sup>77</sup> Rural broadband associations confirmed that “the very filing of these petitions, let alone the prospect of a major license overhaul, has cast a pall of regulatory uncertainty over the CBRs band.”<sup>78</sup> For these companies, it is already “after the fact” and the adverse impact is already being felt.<sup>79</sup>

WISPA’s recent survey puts these statements in a statistical context. *Sixty percent* of the survey respondents indicated that they had reduced investment and/or curtailed deployment in the 3650-3700 MHz band in response to the threat of changes to the PAL licensing rules. That translates to millions of dollars sidelined and thousands of consumers without fixed broadband

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<sup>75</sup> Letter from Anthony Will, Vice President, Broadband Corp, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 24, 2017). *See also* Letter from Patrick Parks, President, SmartBurst LLC, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 24, 2017), at 1 (“We have invested in and deployed equipment and currently provide services to users in this 3650-3700 MHz band and plan to continue to do so *unless the Commission adopts the proposal of the CTIA and T-Mobile due to the uncertainty it proposes*” [emphasis added]).

<sup>76</sup> Comments of Vivint Wireless, Inc., GN Docket No. 12-354 (filed July 24, 2017) (“Vivint Comments”), at 1, 2. *See also* Letter from Richard Bernhardt, Managing Director, Bernhardt Communications Company, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 24, 2017), at 2 (“These proffered changes [by the Petitions] would devastate opportunities for WISPs and many others smaller and varied entities (than large providers) ability to enter, use and provide services under CBRs”); Letter from Craig Brown, Chief Executive Officer, Blueriver Networking Services, Inc., to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 24, 2017), at 2 (“To have this investment obsoleted in the short term by adopting the recommendations in the CTIA and T-Mobile petitions would be a devastating financial blow for a company such as ours”); Wabash Letter at 2 (“If adopted, the mobile industry’s proposals would undermine our existing investment in 3650-3700 GHz spectrum and inhibit further investment and deployment in the entire 150 Megahertz of spectrum”).

<sup>77</sup> Comments of Southern Linc, GN Docket No. 12-354, RM-11788 & RM-11789 (filed July 24, 2017), at 2.

<sup>78</sup> Joint Comments of the Rural Wireless Association, Inc. and NTCA – The Rural Broadband Association, GN Docket No. 12-354 (filed July 24, 2017) (“RWA/NTCA Comments”), at 3.

<sup>79</sup> O’Rielly Statement at 8111.

access because many WISPA members are deeply concerned that they cannot effectuate business plans without PAL spectrum.

Undeniably, there has been significant investment and deployment in reliance on the rules adopted in 2015, and undeniably that investment has slowed in fear of the changes to the PAL rules the Commission is considering. This reduction in investment would not have occurred to such an extent if fixed wireless broadband providers were content with using GAA spectrum. The Commission cannot lose sight of the impact its decision will have on those rural broadband providers that see this band – and the ability to access PAL spectrum – as “make or break” for their businesses and, more importantly, for rural Americans that await fixed broadband service.

## **II. THE COMMISSION SHOULD RETAIN THE EXISTING PRIORITY ACCESS LICENSING RULES**

Turning to the specific issues in the *NPRM* concerning PAL licensing, WISPA responds first to the most troubling aspect of this new proceeding – the possibility that the Commission may fundamentally alter the basic spectrum assignment approach for the band, including potentially making each of the following harmful revisions: (1) increasing the geographic size of PAL license areas from census tracts to much larger Partial Economic Areas (“PEAs”), (2) extending PAL license terms to a full ten years, indistinguishable from other Commission-issued wireless licenses, and (3) adopting a *de facto* renewal expectancy for PALs, effectively allowing these licenses to be held permanently by the initial licensee. All of these proposed mutations of the original rules do substantial harm to the innovative and adaptable licensing approach that the Commission crafted less than three years ago and heralded as “a comprehensive regulatory scheme to promote development of innovative technologies and

services.”<sup>80</sup> As Dr. Lehr states, “[t]he rule changes under consideration . . . would effectively foreclose economically viable access to the spectrum for large classes of commercial users, denying consumers the benefits of increased competition and innovative new services, including expanded, cost-effective access to rural broadband services.”<sup>81</sup>

#### **A. The Commission Should Retain Census Tracts As The Geographic Area For Priority Access Licenses**

Notably, the Commission does not propose in the *NPRM* to enlarge PAL areas, but seeks public comment “on the potential effects of this change on investment in and use of the 3.5 GHz Band [and] whether a larger license area would provide additional flexibility to facilitate the deployment of a wide variety of technologies, including 5G.”<sup>82</sup> More specifically, the Commission asks for comment on increasing the license size to encompass entire PEAs “and how this would affect investment in PALs – both investments currently underway and future PAL investment – and diversity of PAL uses and users.”<sup>83</sup>

As a threshold matter, the current CBRS rules do not prevent mobile carriers, or any industry or use case, from bidding on PALs and acquiring the geographic areas they desire. But the opposite is *not* true – “the willingness-to-pay for protected PAL spectrum is better matched to the available spectrum resources, making it more likely that there will be an efficient allocation if there are multiple users contending for access.”<sup>84</sup> Based on the record developed in response to the Petitions, the discussion below concerning the value that providers place on PALs and the findings reported in the Lehr Analysis, it is crystal clear that expanding the size of PAL areas will generally preclude all use cases except those favored by mobile carriers from

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<sup>80</sup> *CBRS Order* at 3963.

<sup>81</sup> Lehr Analysis at 3.

<sup>82</sup> *NPRM* at 8080 (¶ 23).

<sup>83</sup> *Id.* (¶ 24).

<sup>84</sup> Lehr Analysis at 11.

participating in PAL auctions. Contrary to statutory mandate, this outcome would limit flexibility in deploying a “wide variety of technologies,” strand investment by small broadband providers and equipment manufacturers made in reliance on the rules adopted in 2015, curtail future investment, and dramatically limit diversity of uses. These harms will not exist in a vacuum, but will have a profound adverse effect on rural broadband providers and their prospective customers, and the American economy as a whole.<sup>85</sup> In short, the promise of the CBRS band to help bridge the digital divide will become a bridge to nowhere.

**1. Adopting License Areas Larger Than Census Tracts Will Foreclose Small Companies From Participating In Priority Access License Auctions**

Auctioning PALs for areas larger than census tracts will undoubtedly foreclose small companies from participating, leaving a few large companies to bid among themselves for increases to their rich portfolios of licensed spectrum. Small providers seeking to acquire PALs for small, targeted areas should not be forced to compete for PALs covering huge areas such as PEAs. Dr. Lehr explains the problem:

Unfortunately, the contribution that BWA providers have made toward solving the rural broadband deficit and to adding to the competitive landscape for broadband services is put at risk by the proposed changes to the licensing framework. The proposed revisions to the PAL framework would essentially foreclose the ability of potentially all BWA providers from acquiring PAL spectrum. A typical BWA provider would find the coverage of a PEA more than an order of magnitude larger than the BWA’s addressable market.<sup>86</sup>

A few statistics and examples demonstrate how PEA auctions will effectively foreclose competitive bidding from small providers. Overall, 337 of the 416 PEAs have a population of

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<sup>85</sup> See Lehr Analysis at 3-4 (“Diminished access to the band by a large class of potential infrastructure investors could easily result in a \$20 billion per year or more reduction in consumer welfare associated with higher pricing for broadband services and, more importantly, resulting from decelerated access to spectrum for fixed wireless broadband deployment in rural areas and delayed or denied realization of the benefits of localized wireless networks for IoT-driven innovations that are potentially worth hundreds of billions of dollars to the U.S. economy”).

<sup>86</sup> *Id.* at 19 (footnote omitted). BWA is an acronym for “broadband wireless access.”

more than 100,000, whereas the typical population of census tracts is about 4,000.<sup>87</sup> Stated another way, for every one PEA there are 178 census tracts. That means that a bidder wishing to acquire the benefits of protected 3.5 GHz spectrum to serve a rural community or IIoT installation located in a single census tract would have to acquire, on average, a PEA containing 178 separate census tracts at, on average, 178 times the cost (and not accounting for any increase in price inherent in longer and renewable licenses as proposed in the *NPRM*). PEAs also vary widely in size. For instance, PEA1, the most populated PEA, includes 6,039 census tracts, many of which have low population densities where rural broadband providers are more likely to want to serve.<sup>88</sup> Thus, many rural areas outside of major non-rural areas are lumped into large non-rural PEAs, where they constitute a small percentage of the population. It is not realistic to require a small provider to bid for the entire PEA when it desires to serve a handful of census tracts.

The map in Appendix F hereto illustrates that this problem is not confined to PEAs with significant population, but extends to rural PEAs with low population. PEA 278 covers 5,880 square miles of Southeastern Kansas and Northeastern Oklahoma and includes a population of 179,889 in 10 mostly rural counties. Within PEA 278 are 60 census tracts, with an average population of about 3,000. A WISP or other bidder seeking to cover a private venue or to serve a farm with agricultural management services with PAL spectrum would be forced to be the highest bidder for the entire PEA of 179,889 people, 5,880 square miles, 60 census tracts and ten counties, even though the bidder desires only to serve one or a few census tracts where demand for its service exists.

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<sup>87</sup> See *CBRS Order* at 3991 and n.223.

<sup>88</sup> See Appendix E hereto. Within PEA 1 are 318 census tracts having an area of at least 10 square miles (shown in green) that can be deemed “rural” under any reasonable standard. The average population of these tracts is 3,501.

Undoubtedly, that bidder's business model would not justify a bid that is likely to be successful. The "order of magnitude" discrepancy cannot be overcome. The result is a foregone conclusion – PALs will be gifted to the few large carriers that can support a business model predicated on large-area PEAs; and a wide variety of uses, including rural broadband networks, will be confined to sharing GAA channels made more congested by PAL auction foreclosure.

The results of the broadcast incentive auction illustrate the ultimate outcome. In that auction, the first to use PEAs, the vast majority of licenses were acquired by multi-billion dollar global and nationwide companies. Of the 2,776 licenses that were auctioned, 2,295 were won by just five bidders – T-Mobile, DISH Network, Comcast, AT&T and U.S. Cellular, with T-Mobile itself acquiring more than 50 percent of the licenses. The other 45 winning bidders accounted for the remaining 481 licenses. Thus, more than 82 percent of the 600 MHz PEA licenses were bought by just five companies, all of which are large, well-entrenched mobile wireless or broadband companies.<sup>89</sup> If the Commission adopts PEAs for PAL auctions, a similar outcome will no doubt result.

Licensees holding PEA-sized areas are also likely to concentrate their deployments in urbanized areas within each PEA in order to increase spectrum *capacity*, not spectrum *coverage*. Of the 74,002 total census tracts, 53,910 have a land area of 10 square miles or less. Collectively, these census tracts hold 71.1 percent of the population, yet occupy only 2.9 percent of the land area. These areas are conducive to small cell deployment to densify mobile networks in areas where the population is highly concentrated. By contrast, 97.1 percent of the land area is in census tracts having greater than 10 square miles, but only 28.9 percent of the population lives

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<sup>89</sup> See *Public Notice*, DA 17-314 (rel. Apr. 13, 2017), at Appendix B.

there.<sup>90</sup> These areas are mostly rural areas where there is the greatest need for fixed broadband coverage, which can be enabled via PAL spectrum. In addition, as Dr. Lehr explains, “the national cellular providers’ businesses and networks are not dependent on having contiguous geographic coverage in the CBRS or any other band. *Indeed, having such coverage would likely result in the spectrum being under-utilized in many less-densely populated areas where the national cellular operators do not confront capacity constraints.*”<sup>91</sup> Conducting PAL auctions by PEAs would effectively consign rural Americans to sharing a limited and declining supply of congested, unlicensed or “license by rule” spectrum, destroying any opportunity for PALs to be available to help meet the broadband access challenge that leaves millions of Americans unconnected.

The Commission seeks comment on alternatives to PEAs, including assigning PALs by counties as NCTA and Charter suggest.<sup>92</sup> WISPA appreciates efforts to find an alternative approach, but county-sized licenses, especially in Western states, remain too large for localized deployments that are better suited – and in many cases *only* suited – for census tract deployment. On average, counties hold about 23 times the population of census tracts; many counties cover thousands of square miles<sup>93</sup> and more than half the population of the United States lives in just

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<sup>90</sup> See Appendix G hereto. Table 1 shows that population is more concentrated in census tracts with smaller geographic areas. Table 2 in Appendix G demonstrate that, in PEAs with a population of greater than 1 million, a substantial portion of the population lives in census tracts that have a low population density.

<sup>91</sup> Lehr Analysis at 8 (emphasis added).

<sup>92</sup> See *NPRM* at 8081 (¶ 25).

<sup>93</sup> For instance, San Bernardino County, California has a total area of 20,160 square miles. See *San Bernardino County By the Numbers*, SAN BERNARDINO CNTY., available at <http://wp.sbcounty.gov/cao/countywire/wp-content/uploads/2014/02/County-by-the-Numbers-2-26-141.pdf> (last visited Aug. 2, 2017). All of the 100 largest U.S. counties in area have areas of at least 4,000 square miles. See *American FactFinder County Area Table U.S. Census 2010*, U.S. CENSUS BUREAU, available at <https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk> (last visited Aug. 2, 2017).

146 counties.<sup>94</sup> In many states counties vary greatly in size, and may even have non-contiguous areas. For these reasons, counties are not an acceptable geographic unit for PALs.

The digital divide is fundamentally a last-mile problem. Unserved areas are often scattered throughout counties (and PEAs). If the Commission is committed to addressing the digital divide, it needs to allocate spectrum in small, discrete areas, so that operators can target their investment to areas that are unserved.

Implicit in a proposal to enlarge PAL areas is the notion that rural Americans should be satisfied with the current inventory of unlicensed and, in some cases, licensed spectrum, or that GAA use will be sufficient to meet the demands of rural Americans. These inferences are entirely false. WISPA's interest in this proceeding since 2012, when the mobile industry expressed little or no interest in the band at all, together with the investment made over the past three years in reliance on the spectrum access model the Commission adopted in 2015, more than illustrates demand for spectrum that enjoys interference protection. Moreover, those rules were specifically adopted to lower barriers to the acquisition of PALs to promote innovation, investment and actual commercial deployment to those that lack access to fixed broadband today. The experiments, investments and deployments made in the intervening years demonstrate that existing spectrum inventory is insufficient and unsustainable, and the decline in investment from the threat of changes to the PAL rules shows that PALs are highly valued by WISPA's members. Continued exclusive reliance on an ever-dwindling supply of unlicensed spectrum is not an option for rural America.

Also implicit is the notion that small companies should not participate in the 5G economy. This, too, is a false premise. Small broadband companies are among the most

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<sup>94</sup> See Robbie Gonzalez, *Half of the U.S. lives in these 146 counties – is yours one of them?*, Sept. 5, 2013, available at <https://io9.gizmodo.com/half-of-the-u-s-lives-in-these-146-counties-is-yours-1258718775> (last visited Aug. 1, 2017).



innovative spectrum users – they’ve converted Part 15 “junk bands” into successful businesses. Rise Broadband has 170,000 fixed broadband customers in 16 states. WISPs are deploying fixed LTE-based services at a rapid rate, with more than 63 percent of WISPA’s survey respondents reporting that they have already invested and deployed in reliance on the rules adopted in the *CBRS Order*. This trend of innovation by entrepreneurial small businesses will undoubtedly continue so long as barriers to spectrum acquisition are low. Assuming PAL spectrum can be acquired at all, excessive costs will force the Hobson’s Choice of either significantly delayed return on investment or higher prices passed through to rural consumers that are statistically less likely to be able to afford it.

Contrary to the theory that the existing PAL rules may stand in the way of “U.S. leadership in the global race for 5G,”<sup>95</sup> the existing rules will accelerate 5G deployment by allowing a broader and more diverse range of entrepreneurs, innovators and providers.<sup>96</sup> Many of these will be small companies that are the engine of the U.S. economy and can respond quickly to the need for innovation and demand for service. As a recent Maravedis report on 5G fixed wireless concluded, “[f]or broadband customers, the combination of quick access (no waiting for fiber installations) and reliable, gigabit speeds is an appealing incentive to switch from larger providers, who dominate the market while offering poor service. And for the millions of Americans who have no broadband access at all, 5G [fixed wireless access] is perhaps the best option for providing broadband coverage.”<sup>97</sup>

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<sup>95</sup> *NPRM* at 8072 (¶ 2).

<sup>96</sup> See also Lehr Analysis at 10 (“If not foreclosed, CBRS spectrum should be attractive to a diverse range of users with business models that would allow them to provision wireless services rather than having no other choice but to purchase from cellular carriers or rely on unprotected spectrum”).

<sup>97</sup> Maravedis, *5G Fixed Wireless Gigabit Services Today*, at 20, available at <https://go.siklu.com/hubfs/Content/White%20Papers/Maravedis%20Industry%20Overview:%205G%20Fixed%20Wireless%20Gigabit%20Services%20Today.pdf?t=1513866037416> (last visited Dec. 22, 2017).

In sum, the Commission made the correct policy choice in the *CBRS Order*, which acknowledged the need of some bidders to acquire PALs for small geographic areas to promote innovation, investment, and deployment. Unlike PEAs that are an “order of magnitude” larger and thus would effectively foreclose bidding by small entities, census tracts are available to all, and can be combined to create spectrum footprints of virtually any size. There is no reason for the Commission to reverse course, and many reasons to retain the *status quo*.

## **2. Adopting License Areas Larger Than Census Tracts Will Strand Current Investment And Inhibit Future Investment**

The discussion above demonstrates that, in reliance on the current rules that offer low barriers to license acquisition and “facilitate faster deployment of service and allow providers to target smaller populations, meeting the same goals,”<sup>98</sup> many small entities have already made investments to deploy service in the 3650-3700 MHz band to unserved and underserved communities.<sup>99</sup> Given that more than 63 percent of survey respondents have already invested and deployed based on the 2015 rules and 60 percent of those reported they have reduced investment or curtailed deployment simply because of the *threat* of changes to the PAL rules, it is patently obvious that *actually* adopting and implementing the contemplated changes will accelerate the decline in investment and deployment. There can be little doubt that the portion of investment made in reliance on the 2015 rules will be stranded.

Fixed wireless broadband providers require access to PAL spectrum for yet another reason. As discussed above, industry investment and deployment has confirmed the public policy benefits of the rules the Commission adopted in the *CBRS Order*, which has stimulated more rapid commercial deployment of software-defined and software-upgradable equipment in the 3650-3700 MHz band. As a result, WISPA members are seeing increasing congestion

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<sup>98</sup> *CBRS Recon Order* at 5077.

<sup>99</sup> See, e.g., WISPA 2017 Comments; RWA/NTCA Comments.

within the 50 megahertz of spectrum at 3650-3700 MHz, and are concerned that over time they will be unable to sustain growth in the limited 30 megahertz of GAA channels in the 3550-3650 MHz band. This problem will become worse if users are foreclosed from auction participation and are crowded into whatever GAA spectrum may be available. Access to PALs not only would expand the amount of spectrum available for network capacity and coverage, but would also provide protection from interference and enable operators to better manage their networks and ensure higher quality of service for consumers.<sup>100</sup>

In addition, the consequences of auction foreclosure extend beyond the obvious problems of license concentration and sidelined business models that will not get off the ground. Many WISPA members are preparing to participate in the Commission's upcoming Connect America Fund ("CAF") Phase II reverse auction,<sup>101</sup> and some are considering using CBRS spectrum as non-line-of-sight spectrum to meet performance and build-out requirements to serve identified unserved rural areas. While GAA might be usable for some such deployments, PALs provide protection against interference that improves the quality of service for sensitive applications such as voice, the provision of which is a CAF requirement. There is thus an interrelationship between the ability to deploy fixed broadband on CBRS spectrum and the opportunity to obtain federal subsidies to help offset deployment costs and accelerate broadband deployment to defined unserved areas.

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<sup>100</sup> See Lehr Analysis at 20. While a PAL protection area will not necessarily cover the entire service area of a WISP base station, whose fixed subscriber terminals will have directional antennas at higher elevation than mobile devices, a PAL will nonetheless greatly reduce the likelihood of harmful interference.

<sup>101</sup> See *Connect America Fund*, 32 FCC Rcd 1624 (2017).

Another aspect of this interrelationship is that the Commission has tentatively proposed to accept CAF bids for eligible census blocks within census block groups for the CAF auction.<sup>102</sup> Because census block groups nest within census tracts, the opportunity for a WISP to bid on similar – if not identical – small, targeted geographic areas provides a means for efficient deployment of fixed broadband service to unserved rural Americans.<sup>103</sup> Adopting larger PAL areas will destroy this opportunity as well.

### **3. Adopting License Areas Larger Than Census Tracts Will Limit The Diversity Of Use Cases**

The Commission predicts that “the 3.5 GHz Band will play a significant role as one of the core mid-range bands for 5G network deployments throughout the world,” and that “[t]o maintain U.S. leadership in the global race for 5G, we must ensure that service rules governing bands that are critical for 5G network deployments – including the 3.5 GHz Band – keep up with technological advancements, create incentives for investment, encourage efficient spectrum use, support a variety of different use cases, and promote robust network deployments in both urban and rural communities.”<sup>104</sup>

The rules adopted in 2015 and affirmed in 2016 accomplish these objectives, and there is no need to change them. The record of innovation, investment and deployment described above is occurring at the community level. WISPs are deploying in the 3650-3700 MHz band so that,

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<sup>102</sup> See *Connect America Fund*, 31 FCC Rcd 5949, 5979 (2016); *Fact Sheet and Draft Public Notice*, “Comment Sought on Competitive Bidding Procedures and Certain Program Requirements for the Connect America Fund Phase II Auction (Auction 903),” AU Docket No. 17-182, FCC-CIRC1708-01 (rel. July 13, 2017), at 4-5 (“Bidding at the census tract level could be particularly problematic for small providers that may seek to construct smaller networks or expand existing networks because a larger minimal geographic area, *like a census tract or county*, may extend beyond a bidder’s service territory, franchise area, or license area”) (emphasis added).

<sup>103</sup> See Appendix F (depicting census blocks in PEA 278 that are eligible for support in the CAF Phase II reverse auction). See *Public Notice*, “Wireline Competition Bureau Releases List and Map of Eligible Census Blocks for the Connect America Fund Phase II Auction (Auction 903),” AU Docket No. 17-182 and WC Docket No. 10-90, DA 17-1219 (rel. Dec. 19, 2017).

<sup>104</sup> *NPRM* at 8072 (¶ 2) (footnote omitted).

when the CBRS band is commercially available in just a few months, they can edge out their networks into new unserved and underserved areas and can offer competition in other areas. Other companies are trialing a wide variety of other use cases, such as neutral host networks, IIoT and venues.<sup>105</sup> All of these use cases are best suited to a single census tract or a small cluster of contiguous census tracts.

Increasing the size of PAL areas will completely undercut these business models, leaving a single model deployed only by a small group of large incumbents as the only logical bidders for this spectrum. To do so on the assumption that it is necessary to support an as-yet undefined global standard, “5G”, would be foolish and shortsighted. This zero-sum outcome is not what the Commission had in mind when it adopted the *CBRS Order* in 2015, and it is inconsistent with Commissioner O’Rielly’s admonition that the Commission should not “adopt artificial restrictions through license and auction structure to dissuade some uses or users while promoting others”<sup>106</sup> and Chairman Pai’s philosophy of the government staying out of the business of “picking winners and losers.”<sup>107</sup>

To be clear, the opposite is not true – the Commission can still support America’s global leadership in wireless innovation by keeping CBRS rules that enable a broad variety of wireless use cases to co-exist and compete. It is entirely unnecessary to change the rules for the band in a manner that only benefits the mobile wireless use case to the detriment of others. Indeed, true global leadership will be fostered by rules that encourage new and disruptive competitors to enter the wireless marketplace. 5G will still evolve in the CBRS band if the rules are preserved because 5G is in no way dependent on defining and limiting the number of providers or on limiting access to any particular spectrum band; rather, it is a radio technology designed to

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<sup>105</sup> See [Appendix D](#).

<sup>106</sup> O’Rielly Statement at 8111.

<sup>107</sup> Pai RIF Statement at 4.

enhance capacity, speed and latency in any number of spectrum bands.<sup>108</sup> As proof positive of this fact, T-Mobile’s Vice President of Network Technology Development and Strategy was recently quoted as saying that T-Mobile “would look to use [CBRS] spectrum in *whatever form it is available*” – presumably including small areas, short terms and GAA spectrum.<sup>109</sup>

#### **4. The Commission Cannot Rely On Auction Design Mechanisms To Mitigate The Harmful Effects Of Larger License Areas**

The Commission asks whether “package bidding, bidding credits for certain bidders or areas, or other auction design mechanisms [would] be appropriate for us to consider *if we were to increase the license area*.”<sup>110</sup> As a general proposition, package bidding to allow larger geographic PALs to be aggregated would be a step in the wrong direction, regardless of the geographic scope of each license, because large companies could simply bid more money to acquire a package of licenses encompassing a large area, in effect setting their own license boundaries to the detriment of bidders seeking to provide service over smaller geographic footprints. Package bidding may be appropriate, however, if the Commission retains census tracts as the PAL geographic area.

Bidding credits for rural areas or small companies would need to be carefully designed to ensure that they accomplish the Commission’s goals, and depending on how such credits are implemented, may require significant agency staff resources to properly ensure that bidders are

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<sup>108</sup> A recent press report posits that 3GPP’s adoption of specifications for 5G NR “reportedly cover support for low-, mid- and high-band spectrum, from below 1 GHz, like 600 and 700 MHz, all the way up to around 50 GHz, and include the 3.5 GHz band.” Monica Allevan, *3GPP declares first 5G NR spec complete*, FIERCE TELECOM, Dec. 20, 2017, available at <https://www.fiercewireless.com/wireless/3gpp-declares-first-5g-nr-spec-complete> (last visited Dec. 22, 2017).

<sup>109</sup> See Mike Dano, *Charter, Federated tout CBRS momentum, but T-Mobile worries over 5G suitability*, FIERCE TELECOM, Nov. 30, 2017, available at <https://www.fiercewireless.com/wireless/charte-federated-tout-cbrs-momentum-but-t-mobile-worries-over-5g-suitability> (last visited Dec. 10, 2017). See also Lehr Analysis at 11 n.16 (“a local, regional, or even national provider can acquire PALs in markets where it looks as if the risk of congested GAA is higher, while avoiding those costs in markets where congestion is unlikely, and use GAA instead. Users may even choose to operate with both PAL and GAA spectrum in the same license area”).

<sup>110</sup> *NPRM* at 8081 (¶ 25) (emphasis added).

eligible for the claimed credits. If implemented, the Commission also would need to ensure that large companies do not abuse the process to gain credits that should not be available to them, as has occurred in prior auctions.<sup>111</sup> Even so, WISPA believes that, standing alone, awarding bidding credits for rural areas or to small broadband providers would amount to a Pyrrhic victory because these bidders would still be forced to bid on areas that are on average 178 times larger than census tracts. That ensures one of two untenable outcomes – grossly overpaying for an area much larger than the targeted intended service area, or coming up short in the auction even with the bidding credit.

In sum, WISPA does not believe that package bidding or bidding credits can be implemented in a manner that can overcome the severe prejudicial effect of larger geographic areas for PALs. These auction mechanisms may be appropriate if census tracts are retained.

#### **5. The Commission Can Implement Census Tract Auctions For Priority Access Licenses**

In their Petitions, CTIA and T-Mobile argued that auctioning up to seven PALs in 74,000 census tracts is a “complicated licensing scheme”<sup>112</sup> that will require carriers to evaluate each census tract<sup>113</sup> and challenge SAS administrators and licensees.<sup>114</sup> As the Commission observes, however, two prospective SAS administrators refuted these claims.<sup>115</sup> Sony disagreed that allocating PALs by census tracts would create unnecessary interference risks and unmanageable challenges for SAS administration. Although allocation by census tract requires somewhat more sophisticated spectrum management than allocation by larger geographic units such as PEAs, Sony’s research and development efforts indicate that *the difference between the two approaches*

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<sup>111</sup> See *Northstar Wireless, LLC*, 30 FCC Rcd 8887 (2015), *aff’d in part and remanded in part sub nom. SNR Wireless LicenseCo, LLC v. FCC*, No. 15-1330, slip op. (D.C. Cir. 2017).

<sup>112</sup> CTIA Petition at 9; T-Mobile Petition at 16.

<sup>113</sup> See T-Mobile Petition at 16.

<sup>114</sup> See CTIA Petition at 9.

<sup>115</sup> See *NPRM* at 8080 (¶ 21).

*is minor and extremely manageable with a sufficiently robust database implementation.”*<sup>116</sup>

Google noted that “[n]o candidate SAS administrator has suggested that the existing census tract regulation is beyond its technical capability to implement.”<sup>117</sup> A third prospective SAS administrator, Federated Wireless, did not note any agreement with the petitioners’ assertion that it would be too difficult for SAS administrators to deal with census tracts.<sup>118</sup> That more than 10 parties submitted applications to be SAS administrators *under existing PAL census tract licensing rules* provides further evidence that concerns about the complexity of conducting auctions for census tracts are empty claims that do not withstand even cursory scrutiny.

The Commission also should give great credence to the views of economist Paul Milgrom, who co-invented the simultaneous multiple round auction that has been utilized by the Commission and other countries for spectrum auctions.<sup>119</sup> Professor Milgrom concludes that “for PALs for the 3.5GHz band, simple auctions for tens of thousands of licenses are feasible and reasonable.”<sup>120</sup> The Milgrom Paper points to the “real-world evidence” of eBay auctions with about one billion active listings and web site visits that trigger auctions for the right to show an advertisement, demonstrating that “there is no technical reason that an auction platform cannot

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<sup>116</sup> Letter from James Morgan, Director and Counsel, Sony Electronics Inc., to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 21, 2017), at 1-2 (emphasis added).

<sup>117</sup> Google Comments at 25.

<sup>118</sup> See Comments of Federated Wireless, Inc., GN Docket No. 12-354, RM-11788 & RM-11789 (filed July 24, 2017). Despite its agreement with Petitioners that census tracts “could be burdensome,” even Nokia, which applied to be an SAS administrator, stated that it is “important that the Commission also explore the desirability for smaller geographic license sizes...” See Comments of Nokia Comments, GN Docket No. 12-354, RM-11788 & RM-11789 (filed July 24, 2017), at 6.

<sup>119</sup> See Letter from Paul Milgrom, Auctionomics Inc., to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed Aug. 7, 2017) (“Milgrom Paper”), at 1.

<sup>120</sup> *Id.* at 2.



simultaneously manage tens of thousands of PALs, nor any inherent reason that bidders must be overwhelmed by or unable to navigate such a system.”<sup>121</sup>

In addition, the Commission recently completed the broadcast incentive auction, which is universally regarded as the most complex spectrum auction in history. If the Commission can construct a complex reverse and forward auction that enables companies like T-Mobile to spend billions of dollars on licenses, it can certainly design and implement simple, straightforward auctions for census tracts.

Assuming *arguendo* the Commission is somehow convinced that conducting a large number of very simple auctions is too complex an undertaking, its desire for administrative ease should not trump the need to meet the true “complex” challenge of meeting rural America’s need for cost-effective broadband. The solution is not to enlarge the geographic areas, limit participation to a handful of bidders and call it a day. Instead, the Commission can implement other auction models, such as a one-round, sealed bid auction that would be very simple to administer. Any eligible party could submit a single bid for its desired census tract, and the Commission would select the seven highest bids. Or the Commission could implement a rolling auction that makes PALs in some geographic areas available for bid before others, thereby reducing the inventory of census tracts for each phase of the auction until all PALs in all census tracts are auctioned. Other innovative auction designs are also possible. In sum, if necessary, there are ways to make the PAL auction less complicated and less harmful to investment and auction participation than simply reducing the number of auction lots and foreclosing participation by all but one use case.

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<sup>121</sup> *Id.* See also Comments of Starry, Inc., GN Docket 12-354 (filed July 24, 2017), at 5 (“The Commission clearly has the expertise and skills to construct an effective auction for PALs, the only unique characteristic of which will be the number of lots up for auction”).

## **B. The Commission Should Not Extend Priority Access License Terms To Ten Years**

The Commission proposes to increase the PAL license term from three years to ten years.<sup>122</sup> WISPA strongly disagrees with this proposal. First, lengthening PAL license terms will make PALs more expensive, potentially driving many smaller bidders away and decreasing contention for the spectrum. Second, assuming that the large carriers continue to not make spectrum available in the secondary market, adopting a ten-year term would lower the licensee's opportunity cost and lower the incentive of the licensee to use the spectrum in an efficient manner. Third, bidders seeking longer terms and bidders seeking shorter terms can both participate in the PAL auction; longer license terms would preclude participation from those that desire shorter terms, but does not prevent bidders seeking long-term licenses from bidding. As Dr. Lehr observes, "[w]ith shorter, non-renewable licenses, a licensee who wants more spectrum over a longer duration than a single license can participate in subsequent license auctions. With shorter license terms, both those seeking spectrum for long durations and short durations can participate on closer to equal terms."<sup>123</sup>

The reason the mobile industry desires ten-year terms is apparent from their own statements. CTIA has made clear that the mobile industry has no short-term plan to deploy in the CBRS band given the long lead time it will take for the industry to finalize an international 5G standard, develop handsets, design networks, obtain access to sites, and finally deploy (and maybe then not even to rural areas).<sup>124</sup> So a longer license term enables the license to remain unutilized while at the same time foreclosing users who desire to not rely on opportunistic GAA

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<sup>122</sup> See *NPRM* at 8076 (¶ 13).

<sup>123</sup> Lehr Analysis at 14.

<sup>124</sup> See Reply Comments of CTIA, GN Docket No. 12-354, RM-11788 & RM-11789 (filed Aug. 8, 2017), at 5 ("The shorter license term likewise does not account for the challenges associated with standards development, equipment certification and production, and network deployment, all of which can take multiple years").

spectrum. By contrast, the record of innovation, investment and deployment that is already occurring doesn't need years – it just needs the Commission to greenlight the SAS and ESC, certify equipment and conclude this proceeding in an acceptable manner – all of which will likely occur in just a few months. It will be then, not in the “multiple years” indicated by the mobile wireless industry, that investment can accelerate anew and services can begin to take off, helping to cement the country's global leadership goal in the manner envisioned by the *NPRM*.

WISPA has indicated a willingness to consider a slight modification in the length of the PAL license term to five years with the ability to renew for one additional five-year term,<sup>125</sup> but has also cautioned that any change in the existing license term must not be coupled with *any* change in the size of the PAL geographic auction area.<sup>126</sup> Any further changes would position PALs far beyond the financial reach of innovators and operators that desire to use the band in harmony with each other and, if they are so inclined, the proponents of 5G services.

### **C. The Commission Should Not Allow Licenses To Be Permanently Renewed**

In response to the Petitions giving rise to this proceeding, the two largest national mobile carriers touted long-term, easily renewable licenses as “traditional” for the existing mobile bands, and argued that the identical approach should now be adopted for CBRS.<sup>127</sup> This appeal

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<sup>125</sup> See WISPA 2017 Comments at 19-20. See also Comments of Ruckus Wireless, GN Docket No. 12-354, RM-11788 & RM-11789 (filed July 24, 2017) (“Ruckus Comments”), at 9 (willingness to consider “minor adjustments to the PAL structure that would benefit all participants”) (emphasis in original); Comments of Motorola Solutions, Inc. in Response to Petitions for Rulemaking, GN Docket No. 12-354 (filed July 24, 2017) (“Motorola Comments”), at 5 (“Recognizing that balancing competing needs sometimes requires a degree of compromise, should the Commission choose to lengthen the PAL license term, we suggest extending the term to no more than a 5-year term, with a single (one-time) license renewal allowed”).

<sup>126</sup> See WISPA 2017 Comments at 20. Motorola also stated in reference to the Petitions' requests for increased PAL area sizes to PEA's, 10 year license terms, and T-Mobile's request that PAL licenses not be restricted to 70 of the 150 MHz available in the band, that “[t]aken together, these three proposals could largely eliminate the availability of the CBRS band for private and secure broadband networks.” Motorola Comments at 3.

<sup>127</sup> Comments of AT&T Services, Inc., GN Docket No. 12-354, RM-11788 & RM-11789 (filed July 24, 2017), at 6 (“traditional ten-year license term with renewal expectancy has enabled licensed providers the

to the “old school” way of doing things, in and of itself, suggests a powerful argument for rejecting it. The appeal to “tradition” alone is often a mere justification for doing the same things in the same way without actual consideration or implementation of potentially better alternatives – and for the benefit of those who sit at the top rung of the existing policy or economic ladder. That view may be appealing to entrenched incumbents, and perhaps to those lucky enough to have ready access to multiple broadband providers, but it is not so attractive to others who seek to innovate, to provide new or alternative services, or who seek access to broadband services in areas that remain unserved or underserved. That is, those who seek significant positive change in the *status quo*.

To achieve different results requires both the imagination to envision new approaches and the fortitude to follow through on them. In its *CBRS Recon Order*, the Commission implicitly recognized the need to implement such new approaches, noting that “[n]on-renewable, short-term licenses are an essential component of this overall framework [and] allow operators to obtain PALs when and where Priority Access to the band is needed while permitting periodic, market-based reassignment of these rights in response to changes in local conditions and operator needs.”<sup>128</sup> As Ruckus Wireless pointed out in response to the Petitions, “[i]f Priority Access is licensed at the PEA level with a virtually perpetual duration, it would rule out that access for all aside from those companies whose business models are based on selling services covering huge areas over very long periods.”<sup>129</sup> Perpetually-renewable licenses themselves act as much as a financial asset as an actual license to transmit. History shows many such instances of speculative licensing, and of companies being valued for their license holdings more than for

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needed certainty to invest, deploy, and innovate”); Comments of Verizon, GN Docket No. 12-354 (filed July 24, 2017), at 4-5.

<sup>128</sup> *CBRS Recon Order* at 5022.

<sup>129</sup> Ruckus Comments at 8.

their enterprise value. Such licenses, like real estate, tend to appreciate in value. Short-term CBRS licensing breaks that mold, as non-renewable licenses themselves depreciate and thus have little value unless actually utilized.

The combination of smaller license area, shorter license terms and a near-term opportunity either to reacquire or to forsake a PAL license creates multiple discrete incentives that allow service providers to think in different ways about deployment. Lower upfront capital costs allow operators to experiment with novel service models with less risk, and then seek to expand or contract their service footprints based on experience. Those that succeed will have added incentive at the end of a three-year license term to acquire the spectrum rights for an additional three-year term, while those who find their service model lacking will have an opportunity to exit or to modify their approach, but with the advantage of having risked less and the potential to recoup their smaller upfront investment through sale of equipment to other providers or by continued operation as GAA.

The Milgrom Paper suggests a further innovation to the PAL licensing model that would “balance twin objectives: to encourage license turnover when valuable new uses emerge, and to protect investments by incumbent licensees.”<sup>130</sup> Professor Milgrom suggests that the Commission could grant incumbent PAL holders a “foothold” credit at the end of the license term that would enable the incumbent to buy back (*i.e.*, retain) the license at a fraction of the winning bid.<sup>131</sup> WISPA believes this proposal is worthy of further discussion and may afford a licensee the right to extend its license term with an additional investment in the spectrum while also encouraging license turnover when higher-value uses emerge.

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<sup>130</sup> Milgrom Paper at 6.

<sup>131</sup> *See id.*

#### **D. Secondary Market Transactions Are Not An Adequate Substitute For The Benefits Conferred By The Existing Rules**

The Commission proposes to allow partitioning and disaggregation of PALs, asserting that “the ability to partition and disaggregate a PAL will be an effective way to improve spectral efficiency and facilitate targeted network deployments, particularly if the Commission adopts a longer license term or larger license areas for PALs.”<sup>132</sup> WISPA disagrees with this faulty logic.

First, historically, large carriers acquire long-term licenses for large areas, build out first in the urban core where the population is more densely packed, and allow spectrum in rural areas of the geographic license area to remain fallow. Because secondary market transactions are voluntary, there is no mandate that licensees for large geographic areas lease, partition or disaggregate their spectrum. In fact, there often may be no incentive for a licensee to engage in secondary market transactions if the other party would compete with a carrier operating in a different band or if the alienation of spectrum rights would decrease a company’s market valuation based on a MHz-pop formula.

WISPA’s recent survey confirms the inconvenient truth – the large wireless carriers are generally unwilling to make licensed spectrum available on the secondary market. About 25 percent of survey respondents indicated that they had attempted to obtain licensed spectrum from AT&T, Verizon, Sprint or T-Mobile, and fewer than ten percent of those respondents reported being successful.<sup>133</sup> Respondents made the following comments:

- Sprint was non-responsive to our inquiries
- They would not make the licenses available in our area
- They would not engage in any negotiations for spectrum
- Sprint owns all the 2.5 [GHz] spectrum and is not open for leasing.

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<sup>132</sup> *NPRM* at 8083 (¶ 31) (citation omitted).

<sup>133</sup> See Appendix A at A-3.

- Sprint required us to allow their customers unlimited use of the spectrum

Simply put, the facts on the ground show that secondary markets have historically not worked for smaller providers, and there is no reason to think that circumstances will suddenly change just because the Commission authorizes partitioning and disaggregation in CBRS.

Second, as the Commission recognized in the *CBRS Order*, “[d]ivesting large, unwanted swaths through secondary market transactions could impose significant transaction costs.”<sup>134</sup> Small providers would bear these costs disproportionately to larger companies, and new entrants lack experience in secondary spectrum transactions. A far better alternative – the one the Commission adopted in the *CBRS Order* – is to auction census tracts to enable PAL holders to aggregate licenses in smaller areas if they so desire.<sup>135</sup> Not only does this create incentives to build out, it also avoids the need for parties to negotiate partition and disaggregation agreements and make administrative filings to report the transactions, and for the Commission to expend administrative resources in processing and reporting those filings.

Third, there are serious questions about whether a secondary market will be efficient in light of the “chicken-egg problems” noted by Dr. Lehr.<sup>136</sup> Based on the voluntary nature of secondary markets, the inability of WISPA’s members to access the secondary market for licensed spectrum and the foreclosure value stemming from reduced competition for PALs, it is difficult to see how an efficient secondary marketplace will emerge. This leads to the conclusion that Dr. Lehr foresees: “In the absence of efficient secondary markets, the longer the license

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<sup>134</sup> *CBRS Order* at 3993.

<sup>135</sup> See WISPA 2017 Comments at 25; RWA/NTCA Comments at 5 (“entities that wish to serve traditional geographic license areas are free to aggregate multiple contiguous census tracts”); Ruckus Comments at 8 (“the changes would greatly impair the formation of a dynamic secondary trading market for PAL licenses or access, due to the concentration of a smaller number of PAL licenses into the hands of a few very large companies that are not well known for making fallow licensed spectrum available to others”).

<sup>136</sup> Lehr Analysis at 13.

term, the lower the opportunity cost of spectrum to an incumbent licensee, and hence the lower the incentive for the licensee to use the spectrum efficiently. Increasing the prospect of renewability further exacerbates the problem.”<sup>137</sup>

**E. Adopting The Proposed Changes To The Priority Access Licensing Structure Would Be Inconsistent With The Commission’s Obligations Under Section 309(j) Of The Communications Act**

In establishing licensing rules for any service subject to competitive bidding, such as PALs in CBRs, the Commission must follow the overlapping statutory mandates established in Section 309(j) of the Communications Act of 1934, as amended (the “Act”). In particular, under subsection (3) of that provision, which governs both the design of license auctions and the “characteristics of such licenses,” the Commission must seek to promote a series of important public interest objectives.<sup>138</sup> The Commission has explicitly acknowledged these requirements in the *NPRM*, seeking comment on whether the multiple changes it has proposed for consideration would be “consistent with the statutory objectives of Section 309(j),” including “promoting economic opportunity and competition,” “ensuring that new and innovative technologies are readily accessible,” “avoiding excessive concentration of licenses” and “disseminating licenses among a wide variety of applicants;” “recovering for the public of a portion of the value of the of the public spectrum;” and promoting “efficient and intensive use of electromagnetic spectrum.”<sup>139</sup>

As a practical matter, if the Commission were to adopt all of the potential changes to its licensing approach outlined in the *NPRM*, the fundamental conflicts with these, as well as other requirements of Section 309(j) unmentioned by the Commission, would be so stark as to constitute a violation of the statute. For example, in order for spectrum license assignment

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<sup>137</sup> *Id.* at 14 (footnote omitted).

<sup>138</sup> 47 U.S.C. § 309(j)(3).

<sup>139</sup> *NPRM* at 8087 (¶ 42), *citing* 47 U.S.C. §309(j)(3).



policies to promote economic opportunity and competition,<sup>140</sup> they must necessarily make licenses available in a manner that encourages new participants to enter the marketplace and compete with existing service providers. Establishing large license sizes and lengthy license terms that cater to the policy preferences and existing business models of large incumbent service providers would have the opposite effect, reducing opportunities for new entrants and stifling competition before it can emerge. Indeed, in adopting the current PAL licensing rules in 2015, the Commission expressly noted that “the mandate of Section 309(j) strongly supports” the approach adopted then, “particularly in ‘prescrib[ing] area designations,’ of providing economic opportunity to a wide variety of applicants,” and that “the opportunities for participation with much lower capital investment requirements associated with smaller service areas,” would significantly promote access by new entrants.<sup>141</sup> Especially in the face of the record, the Commission cannot reasonably abandon this pro-opportunity, pro-competitive approach without providing a clear explanation why a contrary approach will now, less than three years later, suddenly better promote these important statutory goals.

Similarly, the Commission is directed by the statute to ensure “that new and innovative technologies are readily accessible to the American people.”<sup>142</sup> This statutory directive cannot be satisfied by pursuing the identical licensing approach for each and every spectrum band repurposed for terrestrial wireless use. Both Commissioners Carr<sup>143</sup> and Rosenworcel<sup>144</sup> have correctly observed that innovative technologies require regulatory innovation as well, the kind

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<sup>140</sup> 47 U.S.C. § 309(j)(3)(B).

<sup>141</sup> *CBRS Order* at 3992. WISPA’s concurrently filed Comments regarding the defective *IRFA* describe how the contemplated changes to PAL rules directly conflicts with the final regulatory flexibility analysis adopted in connection with the *CBRS Order*.

<sup>142</sup> 47 U.S.C. § 309(j)(3)(B).

<sup>143</sup> Carr Statement at 8112 (“From my perspective, the 3.5 GHz band is about creating something different”).

<sup>144</sup> Rosenworcel Dissent at 8113.

that is embodied in the existing CBRS rules. As the Commission noted in adopting these regulations in 2015, “[t]he larger, traditional license areas favored by some commenters are inconsistent with our desire to promote innovative, low power uses in this band, such as small cells, which align well with small, targeted geographic areas such as census tracts.”<sup>145</sup> The Commission should continue to pursue these statutory objectives by maintaining the existing PAL licensing structure.

Licenses that cover larger territories, and that are therefore fewer in number and cost more per license, also run counter to a third policy directive set forth in the Act: “avoiding excessive concentration of licenses and ... disseminati[on] [of] licenses among a wide variety of applicants, including small businesses, rural telephone companies, and businesses owned by members of minority groups and women.”<sup>146</sup> With licenses that cover smaller, discrete areas with different market characteristics, the Commission can encourage a wider variety of business models that can co-exist within the broader ecosystem. If the Commission were to reverse course now, and make available only licenses covering large geographic territories, primarily centered on urban markets, it would be following a well-worn path that inevitably leads to large, established carriers purchasing the largest share of spectrum authorizations at auction.<sup>147</sup> This outcome necessarily limits opportunities for newcomers and small businesses generally, including rural telephone companies, minority-owned and women-owned businesses.

At the same time, a pattern of fewer licenses being distributed into fewer hands is likely to have the effect of producing less “efficient and intensive use of the electromagnetic

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<sup>145</sup> *CBRS Order* at 3992-93.

<sup>146</sup> 47 U.S.C. § 309(j)(3)(B).

<sup>147</sup> See *Public Notice*, DA 17-314 (rel. Apr. 13, 2017), at Appendix B (more than 82 percent of 600 MHz PEA licenses bought by just five companies, all of which are large, well-entrenched mobile wireless or broadband providers).

spectrum,” yet another critical statutory goal referenced in the *NPRM*.<sup>148</sup> When larger, established concerns acquire spectrum rights at auction, they are likely seeking to fill holes in their existing network, providing more reliable service to existing customers in areas already served, but not broadly expanding their geographic scope or the ability to reach new users. This can easily result in narrow and uneven deployment focused on high traffic and high population areas, to the detriment of insular, remote, economically deprived and otherwise underserved areas of the country. This outcome is the antithesis of “efficient and intensive use.” As RWA/NTCA pointed out in response to the initial Petitions, ten-year license terms without strict build-out requirements would encourage large providers to accumulate CBRS spectrum, contravening another mandate of Section 309(j), which directs the Commission to prevent stockpiling or warehousing of spectrum.<sup>149</sup> Moreover, it is also contrary to yet one more statutory priority unmentioned by the Commission in the *NPRM*, the objective of ensuring “deployment of new technologies, products, and services for the benefit of the public, including those residing in rural areas.”<sup>150</sup>

Nor would build-out requirements be likely to help. A licensee with a large license area and a build-out requirement to meet could satisfy the requirement in more than one way. Theoretically, it could lease out portions of its license areas to smaller providers whose own build-out would count towards the total. But to expect that to occur flies in the face of experience. A licensee is more likely to build out nominal cells to block opportunistic GAA use by third parties. While most of the mobile carriers’ interest is in small cells, whose intended service range is measured in the hundreds of feet, additional cells could be installed on existing mobile towers that provide at least theoretical coverage of suburban and rural areas, even though

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<sup>148</sup> *NPRM* at 8087 (¶ 42), *citing* 47 U.S.C. §309(j)(3)(D).

<sup>149</sup> RWA/NTCA Comments at 9, *citing* 47 U.S.C. §309(j)(4)(B).

<sup>150</sup> 47 U.S.C. §309(j)(3)(A).

there is no need there for the additional capacity that small cells bring. The large mobile carriers have several lower-frequency bands with wider coverage ranges, and have not come close to exhausting their spectrum in rural areas, so they have no need for small cells in those areas. WISPs, on the other hand, will design their CBRS networks to cover wider areas, especially because CBRS offers a longer range than the 5 GHz band currently popular among WISPs.

Finally, the Commission should consider the negative impact of significantly altering its carefully-crafted CBRS design after adopting the current rules in 2015 and largely retaining them in 2016. Section 309(j) directs that the Commission act with respect to auctioned services in a manner that allows interested parties “sufficient time to develop business plans, assess market conditions, and evaluate the availability of equipment for the relevant services” prior to auction.<sup>151</sup> The fact is that a great number of smaller service providers have relied on the rules that the Commission established in 2015 to develop business plans, evaluate the marketplace, begin procuring the necessary equipment to provide service, and conduct significant experimental trials. A change now, merely to appease the goals of mobile service providers seeking to perpetuate a particular service model, would be harmful to these small and diverse service providers and upset all of these critical statutory goals.

#### **F. The Costs Of The Contemplated Changes To The Priority Access Licensing Framework Outweigh The Claimed Benefits**

The Commission asks commenters to provide a cost-benefit analysis of alternatives to the contemplated rule changes or hybrid approaches,<sup>152</sup> but does not seek the same degree of economic rigor for consideration of increasing the geographic area for PALs to PEAs. Notwithstanding, Dr. Lehr has conducted such an analysis, and has concluded that:

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<sup>151</sup> 47 U.S.C. §309(j)(3)(E)(ii).

<sup>152</sup> *NPRM* at 8077, 8081 (¶ 16, ¶ 25).

The sole beneficiaries of the contemplated changes would be the national cellular providers who would benefit by lower cost access to spectrum, but potentially even more importantly by the reduction in the threat they would otherwise face from increased competition in wireless services.

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On the other hand, the large numbers of smaller local end-users (such as hospitals, entertainment venues and the hospitality industry), rural broadband providers, industrial broadband users, and local small cell infrastructure providers would be harmed by the contemplated changes.<sup>153</sup>

Dr. Lehr conservatively estimates that the contemplated changes to the PAL rules places economic growth opportunities at risk by “potentially reducing U.S. annual GDP by \$4 billion;” “threatening potentially trillions of dollars of benefits for the U.S. economy associated with the growth of IoT applications;” and “[d]iminish[ing] competition could plausibly result in reductions in consumer surplus of \$20 billion.”<sup>154</sup>

### **III. THE COMMISSION SHOULD ADOPT SELECTIVE CHANGES TO THE PRIORITY ACCESS LICENSE AUCTION RULES AND PROCEDURES**

#### **A. The Commission Should Adopt Its Proposals Limiting The Number Of Priority Access Licenses Available At Auction**

Section 96.29(c) currently provides that the Commission will make available one less PAL than has been sought by applicants in a license area unless more than eight applications have been submitted for that area (there are a maximum of seven PAL licenses available in each area). Although WISPA does not accept the view that eliminating Section 96.29(c) would be “[c]onsistent with” its proposed changes to the proposed PAL license rules, as indicated in the *NPRM*,<sup>155</sup> WISPA agrees that the rule should be eliminated. There was no reason for the Commission to depart from its general definition of mutual exclusivity when the rules were

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<sup>153</sup> Lehr Analysis at 31.

<sup>154</sup> *Id.* at 31-32.

<sup>155</sup> *NPRM* at 8077 (¶ 16).

adopted in 2015, and there is no need to retain a rule that artificially limits the number of PALs that can be assigned in an auction.

### **B. The Commission Should Retain The Current PAL Spectrum Aggregation Limit**

The Commission asks whether it should change or delete the current rule limiting PAL holders to 40 megahertz in a given geographic area.<sup>156</sup> WISPA certainly opposes any increase in the ability of any licensee to hold more than 40 megahertz of PAL spectrum in a given license area. WISPA believes that the rules adopted in 2015 struck the right balance and that there is no compelling argument to change the limit.

### **C. The Commission Should Not Allow Bidding On Specific Licenses**

The Commission seeks comment on T-Mobile's proposal to allow bidders to bid on specific PALs rather than have spectrum dynamically assigned by the SAS.<sup>157</sup> WISPA agrees with Vivint, which characterized the proposal as "unnecessary,"<sup>158</sup> and Google, which noted that bidders could select frequencies that would block another bidder from aggregating contiguous spectrum.<sup>159</sup> Arguments in favor of bidding on specific licenses are unavailing – a "stable and predictable" spectrum environment is ensured through the Commission's rules,<sup>160</sup> the SAS and the ESC. The Commission should reject this proposal.

## **IV. THE COMMISSION SHOULD RETAIN ITS RULES REGARDING PUBLIC DISCLOSURE OF CBSD REGISTRATION INFORMATION**

The Commission proposes to eliminate Section 96.55(a)(3) to thereby limit public disclosure of CBSD registration information "that may compromise the security of critical

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<sup>156</sup> See *id.* at 8081 (¶ 27), *citing* 47 C.F.R. § 96.31.

<sup>157</sup> See *id.* at 8089 (¶ 49).

<sup>158</sup> Vivint Comments at 8.

<sup>159</sup> See Google Comments at 28.

<sup>160</sup> *NPRM* at 8088 (¶ 47), *quoting* Comments of Ericsson, GN Docket No. 12-354 (filed July 24, 2017), at 8.

network deployments or be considered competitively sensitive.”<sup>161</sup> Consistent with its earlier Comments and those of Google<sup>162</sup> and OTI/PK,<sup>163</sup> the Commission should not make any changes to the rules. In WISPA’s view, the benefits of transparency encompassed by the existing rule outweigh any claimed harms to security and competition that others have asserted.

The rule requiring public disclosure of CBSD registration information serves a very important purpose. With access to certain basic information, CBRS users will be better able to plan their operations and design their networks in the first instance, and will not have to go to the SAS on a trial-and-error basis to keep asking “How’s this?” Moreover, users will have more data points to determine the “best” available channel rather than having the SAS decide the channel it wants to assign to the user.

The arguments for eliminating transparency ring hollow. The actual locations of most base stations, including small cells, are hard to obscure, as they will usually be visible.<sup>164</sup> Most small cells will use the same LTE-based air interface technology, and it therefore should be easy to identify the carrier from the transmitted signal. There are web sites today that display crowd-sourced signal information about mobile service providers.<sup>165</sup>

For operators such as WISPA’s members that will use Category B CBSDs, Section 96.55(a)(3) requires the SAS to report *less* information than is already required by the Part 90 rules and the registration process that is required for licensees in the 3650-3700 MHz service.

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<sup>161</sup> *NPRM* at 8085 (¶ 37) and Appendix A (proposing to remove Section 96.55(a)(3). Section 96.55(a)(3) states that “SAS Administrators must CBSD registration information available to the general public, but they must obfuscate the identities of the licensees providing the information for any public disclosures.”

<sup>162</sup> See Google Comments at 28-29.

<sup>163</sup> See OTI/PK Comments at 31-33.

<sup>164</sup> See Google Comments at 28-29. Further evidence is found in Verizon Wireless’ March, 2016 DAS license agreement with the City of Boston, a public document, which allows lampposts to be replaced by hollow ones housing small cells. The franchise provides illustrations of what they will look like, making it easy for any competitor to identify the locations of Verizon Wireless’ small cells. See License Agreement between the City of Boston and Verizon Wireless (March 31, 2016).

<sup>165</sup> See, e.g., <https://opensignal.com/networks>.

This makes the claimed benefit of obfuscating CBSD information highly questionable. By the same token, the term “critical infrastructure data” should not be so casually accepted as a basis for eliminating transparency. The Commission’s public ULS database today contains millions of entries about the location and technical and operating characteristics of truly critical services, many of which impact public safety directly. These include such services as Part 90 public safety land-mobile operations and Part 101 microwave links.<sup>166</sup> Likewise, the Commission’s public International Bureau Fixed Service database includes the locations of critical satellite earth station locations and certain technical parameters. Proponents of eliminating Section 96.55(a)(3) have not demonstrated why the Commission should shield from the public *more* information than is already required for filing by site-based Commission licensees and is readily available in publicly accessible databases to enable spectrum planning.

In its current Requirements<sup>167</sup> the Wireless Innovation Forum (“WinnForum”) has interpreted Section 96.55(a)(3) rather narrowly, limiting the public to only the following information:

- FCC identification number
- CBSD class (Category A/Category B)
- Operating indoors or outdoors (for CAT A)
- Air interface technology
- Sensing capabilities (if supported)

The WinnForum Requirements define “Non-Public Registration Data” as “CBSD registration data that would allow one to identify a licensee.”<sup>168</sup> This includes:

- CBSD Licensee name
- Horizontal location (Latitude, Longitude) of antenna

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<sup>166</sup> See *CBRS Order* at 4057 (acknowledging that “[s]ite-based radio services, for instance, typically require all site-based licensing information to be disclosed and available in various FCC databases”).

<sup>167</sup> See Wireless Innovation Forum, *Requirements for Commercial Operation in the U.S. 3550-3700 MHz Citizens Broadband Radio Service Band*, Working Document WINNF-TS-0112-V1.2.0-r6.0 (Sept. 18, 2017), at 43-44.

<sup>168</sup> *Id.* at 44.



- Vertical location (height above ground level) of antenna
- User contact information
- Unique manufacturer serial number
- Maximum EIRP
- Antenna Characteristics – antenna gain, beam width, azimuth, down tilt angle, antenna model
- Call sign

This already makes the SAS public information of very little use, as no location information at all is public. While *exact* coordinates may be considered sensitive, the WinnForum Requirements do not even allow the public to determine whether a device is in Florida or Alaska. A limited-precision location (*e.g.*, to the nearest .01 degree) would at least allow a potential User to determine how many devices are in a given general area.

To the extent Section 96.55(a)(3) is retained, WISPA requests that the Commission clarify that the term “general public” does not include prospective CBRS Users in the same general area. Consistent with the SAS’s obligation under Section 96.53(j) to “facilitate coordination” among Category B GAA users, this clarification would enable the SAS to convey contact information about one CBRS User to another so that they can attempt to privately resolve contention for CBRS spectrum. If the SAS can enable Users to communicate with one another, they will often be able to resolve their issues bilaterally. If only the SAS can know who the Users are and does not share contact information with other Users, then the SAS administrators are more likely to interpret the rule as requiring the SAS itself to resolve all interference issues. This is highly problematic, as the SAS cannot know about *actual* signal conditions at a User location from its propagation models, and may be attempting to over-protect certain categories of User to the detriment of others. Responsibility for resolving contention rests with Users aided by the SAS administrator’s obligation to “facilitate coordination,” but that requires them to be able to communicate with one another in certain circumstances. Accordingly, the Commission should

clarify that a User who has registered a CBSD with any SAS should not be treated as a member of the “general public” for purposes of Section 96.55(a)(3), and that the SAS should be authorized to share contact information with Category B GAA Users to “facilitate coordination” among them consistent with Section 96.53(j).

Users obtaining User contact information from a SAS would be required to protect it. Alternatively, the distribution of User contact information could be limited to the relevant Certified Professional Installer (“CPI”). The cooperation rules in Section 96.35(e) and the SAS coordination functions in Section 96.53(j) apply only to Category B GAA Users, and Category B equipment must be installed by a CPI. The CPI mechanism being developed by WinnForum already has a training and certification requirement, and a CPI will receive a secure certificate-based registration that will protect the use of his or her signature. Disclosure would thus be made to a CPI on behalf of the User, and both of their identities can be retained by the SAS that made the disclosure, as a way to prevent disclosure of the information to the general public.

## **V. THE COMMISSION SHOULD RELAX THE EMISSION MASK**

The Commission proposes to relax the emissions mask to accommodate situations where 10-megahertz channels are combined.<sup>169</sup> In an ex parte presentation preceding the *NPRM*, Qualcomm proposed to modify the emission mask to permit wider channels to be used without the power reductions that would result from applying the current emission mask to current CBSD equipment.<sup>170</sup> Specifically, Section 96.41(e) mandates a -13 dBm/MHz limit at 0-10 megahertz from the assigned channel edge. The Commission seeks comment on Qualcomm’s request to extend the existing limit from 0 to 100% of the channel bandwidth so that, for example, a 20-

---

<sup>169</sup> See *NPRM* at 8100 (¶ 54).

<sup>170</sup> See Letter from Dean R. Brenner and John W. Kuzin, Qualcomm, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed June 19, 2017).

megahertz channel would have a -13 dBm/MHz limit at 20 megahertz on either side of the channel edge. The Commission itself suggests a graduated variation of this proposal in which, for example, a 20-megahertz channel would have a -13 dBm limit in the adjacent 10 megahertz channel and a -20 dBm limit in the second-adjacent channel.

WISPA slightly prefers the Qualcomm approach. The Commission's proposed additional step seems unnecessary because emission masks tend to slope off anyway, so meeting a -25 dB level at B distance from the channel edge suggests that the signal at B/2 will be in between the channel-edge and B levels. Linear interpolation, however, suggests that -19 dB (6 dB from both -13 and -25 dB) is a safer value.<sup>171</sup>

WISPs also face a different problem than small cell operators. WISP customers receiving service via CBRS will be more likely to make use of CBSDs, not End User Devices, as client devices. These will have highly directional antennas, and thus generate a high EIRP across perhaps 6 to 15 arc-degrees, using relatively low conducted power. Thus, out-of-channel emissions will, like the desired emissions, remain tightly focused and have limited aggregation effects. Base station sector antennas will still typically have 14-18 dB of gain. Because the current rules only regulate peak EIRP, a CBSD used at a customer location may generate far less energy out of channel than an omnidirectional small cell or Wi-Fi-like access point with the same EIRP. Were the limits on out-of-channel and out-of-band emission to be stated in terms of conducted power, they would most likely be much easier to achieve at moderate cost. Hence, relaxing the out-of-channel mask will confer a benefit on WISP customers.

In addition, steeper emission skirts require equipment manufacturers to pay very close attention to amplifier linearization, power supply filtering, frequency synthesizer phase noise,

---

<sup>171</sup> If it is adopted, the Commission should clarify that, if the fundamental signal is only 10 megahertz wide, then the -20 dBm/MHz step applied at B/2 would apply only if B is greater than 10 megahertz.

and other parameters that could impact signal quality. Even then, the relatively high peak to average power ratio of OFDM-based modulation can result in some out-of-channel spurs. Hence, even a small amount of relief in the mask can have a substantial impact on cost.

Various parties have expressed concern that looser out-of-channel emissions could prove troublesome. WISPA's membership, however, has extensive experience using unlicensed frequencies that have no out-of-channel requirements, simply out-of-band requirements. From WISPA's perspective, current Section 96.41(e) is unduly restrictive, and even Qualcomm's proposed liberalization is modest. CBRS power levels are relatively low as compared to lower-frequency CMRS bands. At the maximum EIRP of +37 dBm/MHz, even the -13 dBm/MHz value in an adjacent channel will require 50 dB of suppression. This is not impossible, but it is costly. The preponderance of existing 3650-3700 MHz equipment, for instance, is unlikely to have that level of suppression. Thus, if such equipment is updated to CBSD status, it will either have to operate at a substantially lower EIRP, or it will need to create large guard bands within its assigned channels (i.e., operate on a functionally-narrower channel, such as 7 megahertz, and thus provide a lower data rate).

### **Conclusion**

The Commission has a clear policy choice in this proceeding – stay the course with an innovative spectrum licensing model that is already reaping substantial investment and bridging the digital divide, or reverse course for the benefit of a few large carriers that seek to further enrich their treasure chest of licensed spectrum. To WISPA's members – those that work hard every day to deploy cost-efficient spectrum infrastructure to rural Americans – there is only one answer. The Commission cannot undo its PAL licensing rules without undermining its highest policy priority – accelerating broadband access to the millions of Americans that lack service today.

CBRS is the “spectrum tool kit” that offers our country the best opportunity to expeditiously deploy broadband today, and PALs assigned by census tracts and for limited duration provide sustainable spectrum for the future. If it adopts the rule changes that foreclose small broadband providers from acquiring PALs, the Commission will be “picking winners and losers.” And, in this case, the winners unfortunately will be a small class of global carriers and the losers will be American consumers.

Respectfully submitted,

**WIRELESS INTERNET SERVICE  
PROVIDERS ASSOCIATION**

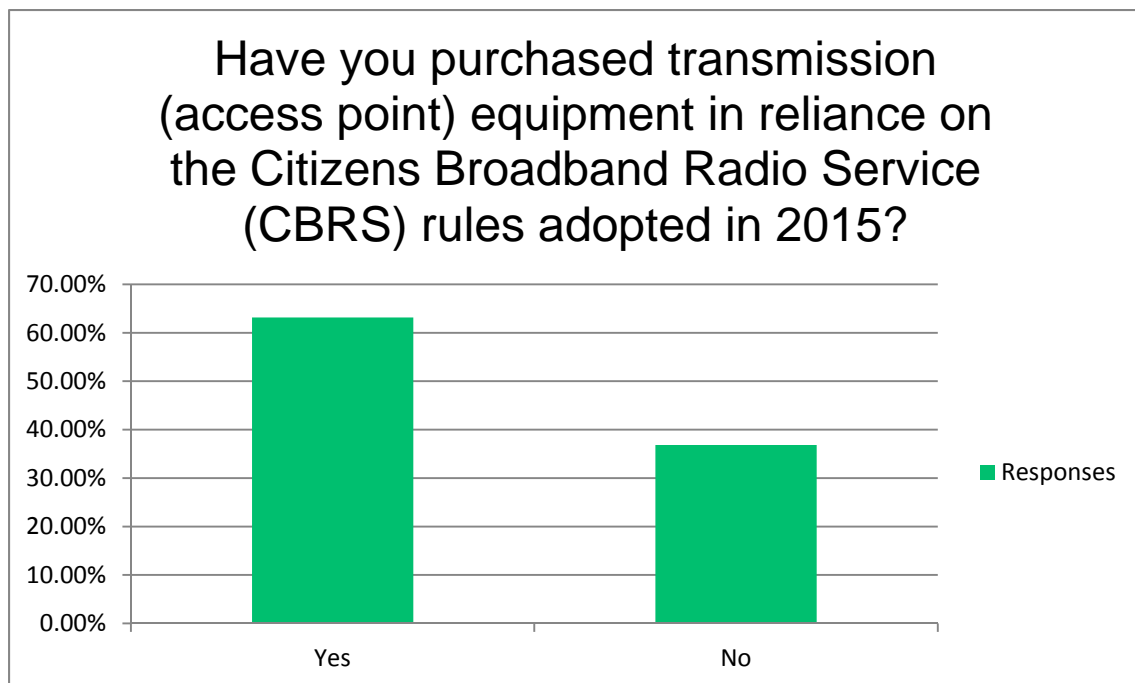
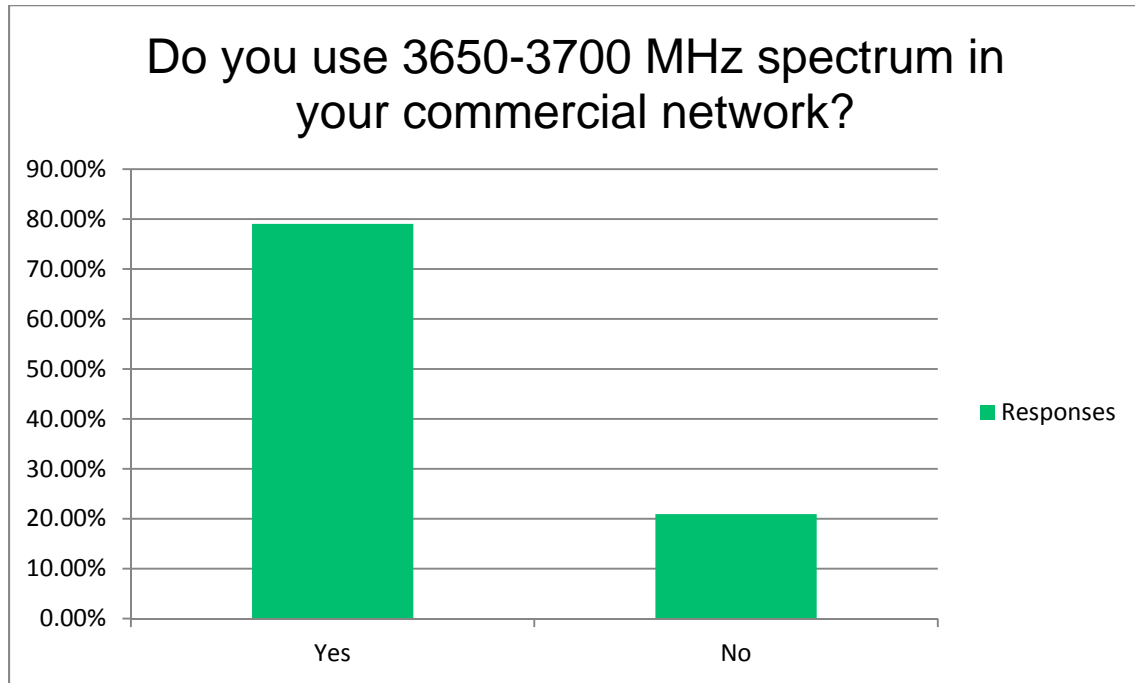
December 28, 2017

By: */s/ Chuck Hogg, Chairman*  
*/s/ Mark Radabaugh, FCC Committee Chair*  
*/s/ Fred Goldstein, Technical Consultant*

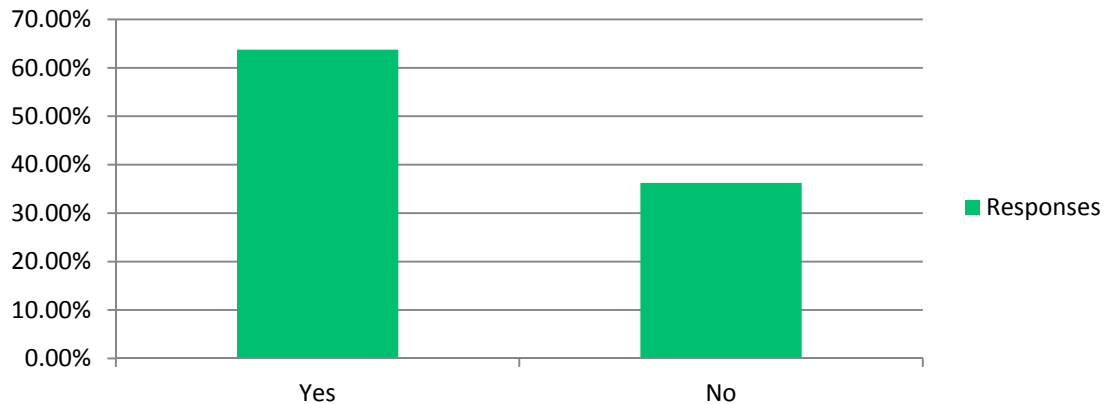
Stephen E. Coran  
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*Counsel to the Wireless Internet Service Providers Association*

## Appendix A

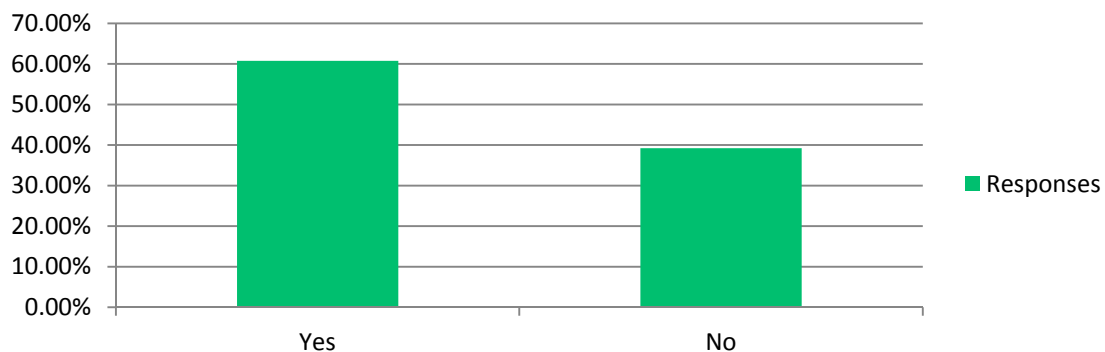
### WISPA Member Survey Results



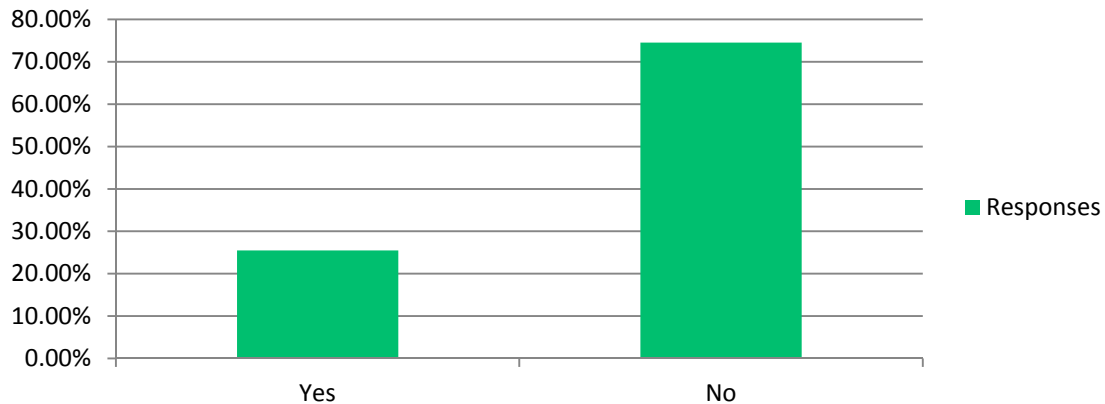
Are you using the 3650-3700 MHz band to provide broadband service to paying customers in reliance on the CBRS rules adopted in 2015?



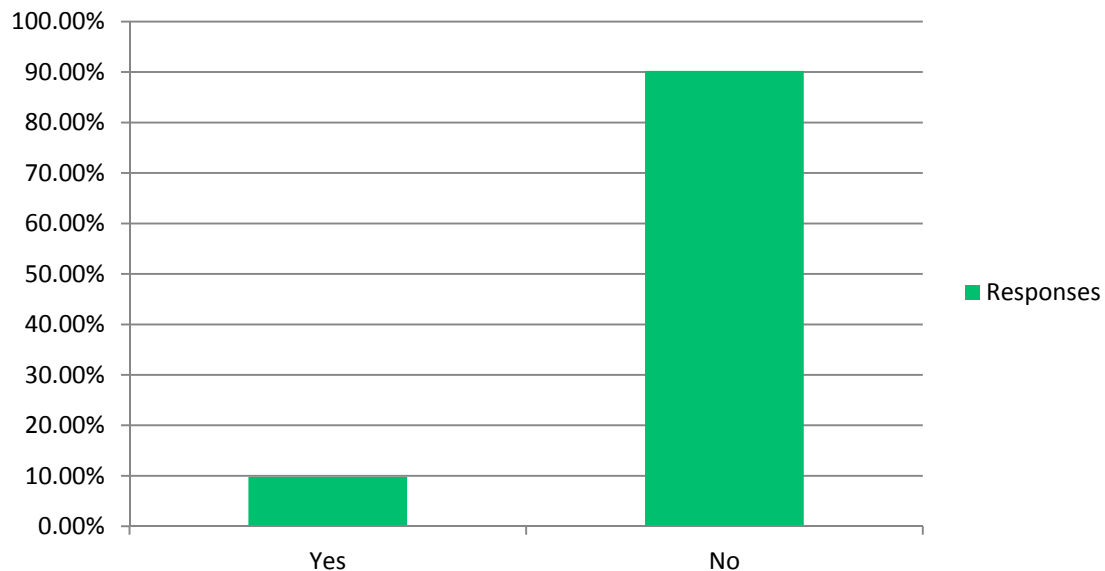
Have you reduced investment and/or curtailed deployment based on FCC proceedings that could result in changes to rules regarding Priority Access Licenses (PALs) in the CBRS band?



Have you attempted to acquire spectrum  
(e.g., 700 MHz, 2.5 GHz) from AT&T,  
Verizon, Sprint or T-Mobile to use in your  
fixed wireless broadband operations?



If yes, were you successful?

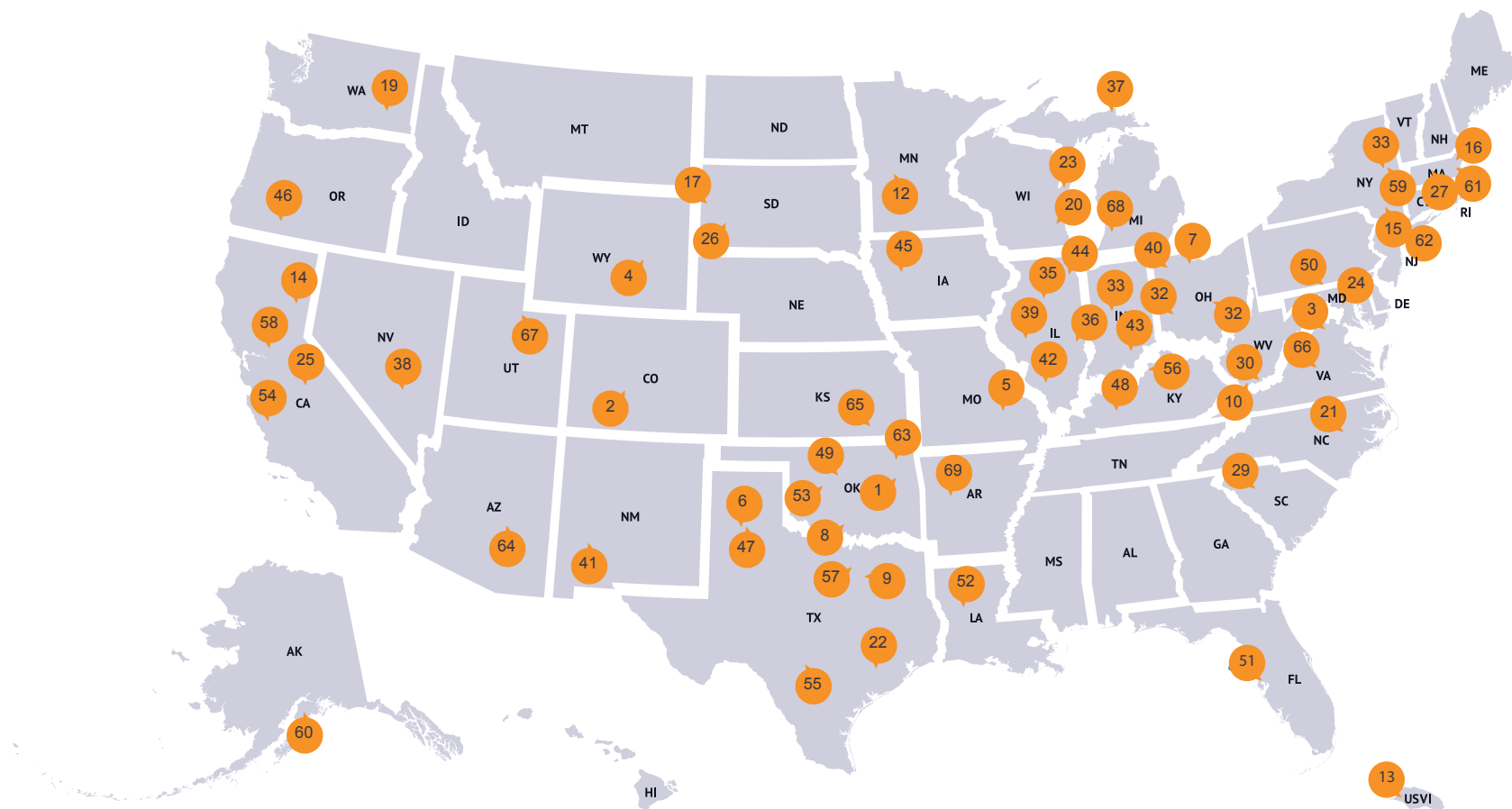




## **Appendix B**

### **Map and List of WISPs Filing Comments in Response to Petitions**

# Companies Across America Oppose CTIA's Radical Changes to the Innovation Band



1 AirLink Internet Services 2 AlignTec Incorporated 3 All Points Broadband 4 Alluretech 5 Alsat Wireless 6 Amarillo Wireless 7 Amplex Electric 8 Arbuckle Communications 9 Baicells Technologies 10 Bland County, Virginia 11 Bolt Internet 12 Broadband Corp 13 Broadband VI 14 Cal.net 15 Cantor Telecom Services 16 Casa Systems 17 Celerity Networks 18 Charter Communications 19 Columbia Energy 20 E-vergent.com 21 Eastern Carolina Broadband 22 EBTX Wireless 23 Excel.Net 24 Federated Wireless 25 Fire2Wire 26 Fourway Computer Products 27 General Electric 28 Gigabeam Networks 29 GlobalVision 30 Google 31 Hudson Valley Wireless 32 Imagine Networks 33 Intelligent Computing Solutions 34 Intelliwave Broadband 35 Internet Communications 36 Joink 37 Lighthouse.Net 38 LTD Broadband 39 Medianet Wireless 40 MetaLINK Technologies 41 Mimbres Communications 42 Motorola 43 New Lisbon Broadband and Communications 44 New Wave Net Corp 45 Northwest Communications 46 PEAK Internet 47 Plains Internet 48 Portative Technologies 49 ProValue.Net 50 Quantum Internet and Phone 51 Rapid Systems 52 REACH4 Communications 53 RF Design Services 54 Ruckus Wireless 55 Rural Texas Broadband 56 Shelby Broadband 57 SmartBurst 58 Softcom Internet Communications 59 Sony 60 SpitwSpots 61 Starry 62 The City of New York 63 The Junction Internet 64 Tropic Networks 65 Valnet 66 Virginia Broadband 67 Vivint Wireless 68 West Michigan Wireless 69 Wireless etc

**Appendix C**  
**Carmel Report**

2017



## Ready for Takeoff:

Broadband Wireless Access Providers  
Prepare to Soar with Fixed Wireless

**THE BWA INDUSTRY REPORT: 2017**

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<ul style="list-style-type: none"> <li>• Fixed wireless costs less</li> <li>• Spectrum trends favor fixed wireless</li> <li>• Video is fueling overall growth in demand for broadband</li> <li>• Standards-based technologies give providers more choices</li> <li>• Capital availability and government support are growing</li> <li>• New entrants are validating the business model</li> <li>• New markets and service categories = more opportunities</li> </ul>	
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# About This Report

The purpose of this report is to provide a comprehensive, independent, informational, and analytical resource that describes the Broadband Wireless Access (BWA) industry and provides perspectives on future opportunities, threats, and outlooks.

The target audience for this report includes BWA companies, stakeholders, investors, policymakers, strategic advisors, analysts, equipment and software vendors, and anyone with an interest in the fixed wireless and broadband industries. The author's aim is to provide objective data and insights to help readers make informed business, investment, and policy decisions.

## METHODOLOGY

This report is based on independent research conducted in 2016, including interviews with representatives of 30 wireless broadband service providers, vendors, and thought leaders. The interviews were conducted by The Carmel Group and lasted approximately two hours each. The Wireless Internet Service Providers Association (WISPA) and Wireless Communications Association International (WCAI), as well as several other groups and telecom companies, also provided input. Filings at the U.S. Securities and Exchange Commission by a publicly traded company in the BWA sector were another resource. Other third parties, such as bankers and financiers, were also interviewed. Finally, extensive surveys of operators, equipment manufacturers, and vendors were distributed to members of WISPA and WCAI in Q3 of 2016, to gain another critical layer of research and analysis.

The charts and graphs in the Appendix are based on survey results from 169 U.S.-based BWA providers.

## THE REPORT SPONSORS

Prominent stakeholders from today's BWA community and two major trade groups representing the industry's interests in Washington, DC – WISPA and WCAI – selected Jimmy Schaeffler of The Carmel Group ([www.carmelgroup.com](http://www.carmelgroup.com)) to conduct this project based upon his expertise in performing studies on the future of the telecom, media, and entertainment industries.

The Carmel Group prepared this report on behalf of the parties listed below.

- All Points Broadband
- Amplex
- AtLink Services
- Cambium Networks
- Comelec Internet Services
- Huawei
- Hudson Valley Wireless
- Mimosa
- RFelements
- Rise Broadband
- Safelink
- SpeedConnect
- Telrad
- TransWorld Network
- ViaSat
- WCAI
- WISPA
- Wisper ISP
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Individuals interested in further information may contact The Carmel Group via telephone at +1-831-622-1111 or email at: [jimmy@carmelgroup.com](mailto:jimmy@carmelgroup.com).

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# Executive Summary



- The Broadband Wireless Access (BWA) industry is experiencing robust growth in the United States and worldwide, and The Carmel Group expects this growth to continue for at least the next five years.
- There are at least seven key growth drivers lifting the fixed-wireless-based, BWA industry to new heights:
  - 1 The economics of wireless technology enable network deployments at a fraction of the cost of wireline.
  - 2 The economics of unlicensed spectrum and trends in spectrum regulation are favorable to fixed wireless.
  - 3 Consumer demands for broadband connectivity and associated applications, especially video, are surging at an exponential rate.
  - 4 Global standards-based technologies, such as LTE, and a growing equipment ecosystem are being leveraged for fixed wireless uses.
  - 5 Industry consolidation and a healthy funding environment from private and government sources are driving investment.
  - 6 New entrants and hybrid networks are validating the business model.
  - 7 New markets in urban areas and categories such as home automation, home security, and the Internet of Things (IoT) present further opportunities for fixed wireless growth.
- Bringing broadband to under-served markets is a difficult challenge. But for the foreseeable future, BWA providers using fixed wireless technologies will offer the most cost-effective solution in vast areas of the United States and the world.
- The existence of large, successful BWA providers in other nations underscores the sector's potential in the United States. Developing nations that lack wireline infrastructure present rich growth opportunities.



# What is Broadband Wireless Access?

Broadband Wireless Access (BWA) providers – also known as Wireless Internet Service providers (WISPs), Fixed Wireless Access providers (FWA), Competitive Broadband Providers (CBPs), and/or Wireless Local Loop providers (WLL) – deliver broadband service to consumers in fixed locations, primarily via wireless technology.

Whereas most wireless infrastructure today serves *mobile* consumers, BWA providers use wireless technology to serve customers in *fixed* locations such as residences, businesses, and community anchor institutions.

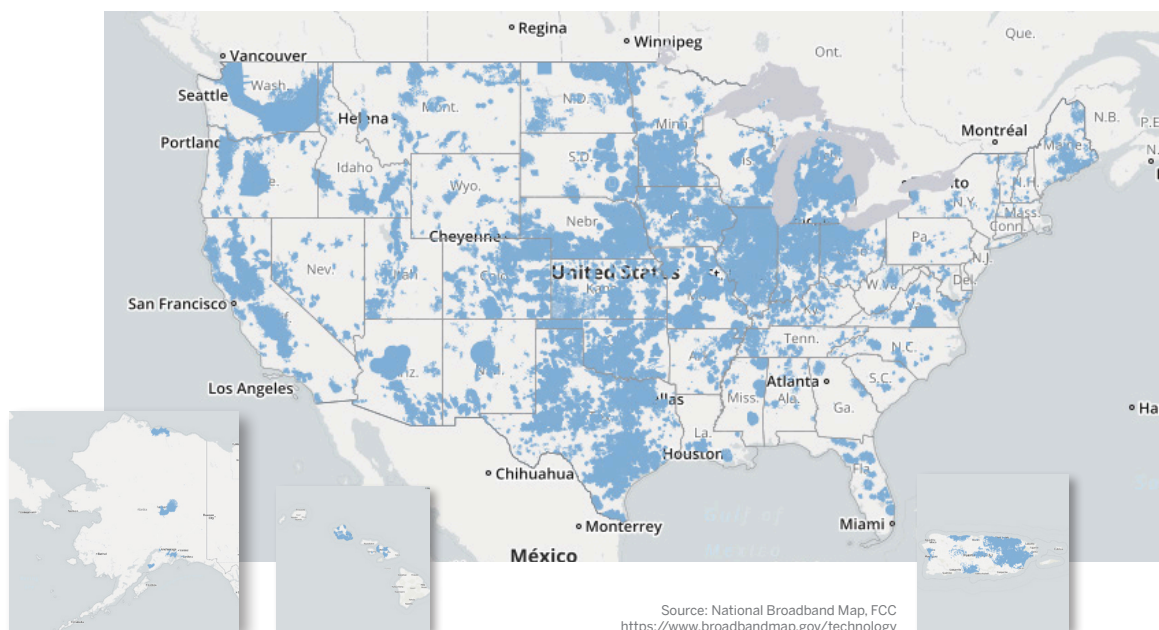
Whereas most wireless infrastructure today serves *mobile* consumers, BWA providers use wireless technology to serve customers in *fixed* locations such as residences, business-

es, and community anchor institutions.

Services delivered by BWA providers may include data as well as voice, video, security, and ancillary products and services.

BWA providers deliver their services over a combination of licensed spectrum, lightly licensed spectrum (or “shared access” spectrum), and unlicensed spectrum. Many also use fiber optics in parts of their infrastructure, creating efficient “hybrid” networks. Typical download speeds are in the range of 5 to 50 Megabits per second (Mbps), a number that is rising as technology improves and equipment costs become more competitive. Fixed wireless technology can support Gigabit download speeds.

**FIGURE 1: U.S. Fixed Wireless Broadband Availability**



Currently in the United States, more than 2,000 BWA providers deliver service to nearly 4 million customers. As shown in Figure 1, each state has at least one fixed wireless provider. The largest concentrations of BWA providers are found in the Midwest, Northwest, and Southwest, as well as the central and northern parts of California.

To date, the industry has served mostly rural and suburban markets where fiber and cable deployment is not cost-effective. However, given the favorable economics of fixed wireless, many BWA providers are expanding into urban markets as well, offering competitive alternatives to customers there.

Most U.S. BWA providers are small and medium-sized businesses. Rise Broadband, with nearly 200,000 subscribers, is the largest U.S.-based BWA provider. Other large providers include AtLink Services, Comelec Internet Services, Safelink, SpeedConnect, Trans-World Network, and Wisper ISP. However, the American BWA networks serve an average of approximately 1,200 customers. Very small BWA providers, especially those that serve small rural communities, may count customers in the low hundreds.

Many BWA leaders interviewed for this study indicated their “ideal” deployment occurs in residential clusters of 100 to 1,500 locations per square mile, areas that wired technology platforms often ignore because of the higher per-location cost to deliver service across sparsely populated areas.

Bringing broadband to under-served markets is a difficult challenge. At this time, BWA providers using wireless technologies are the most cost-effective solution in vast areas of the United States and the world.

# How Does BWA Work?

In a typical BWA network, broadband content is received by the BWA provider from an external distribution point via fiber or microwave connections. From there, signals are delivered to BWA customers via wireless transmitters on towers. The towers are interconnected by licensed or unlicensed spectrum and can carry up to 5 to 10 Gigabytes of capacity. Customers receive the signals via antennas that are attached to the subscribers' premises. This is why the technology is called fixed wireless, as opposed to mobile/cellular wireless.

Within the subscribers' premises, the signal is most commonly delivered via a Wi-Fi router or ethernet cable to personal computers, TV monitors, and other stationary and mobile devices in the home or business.

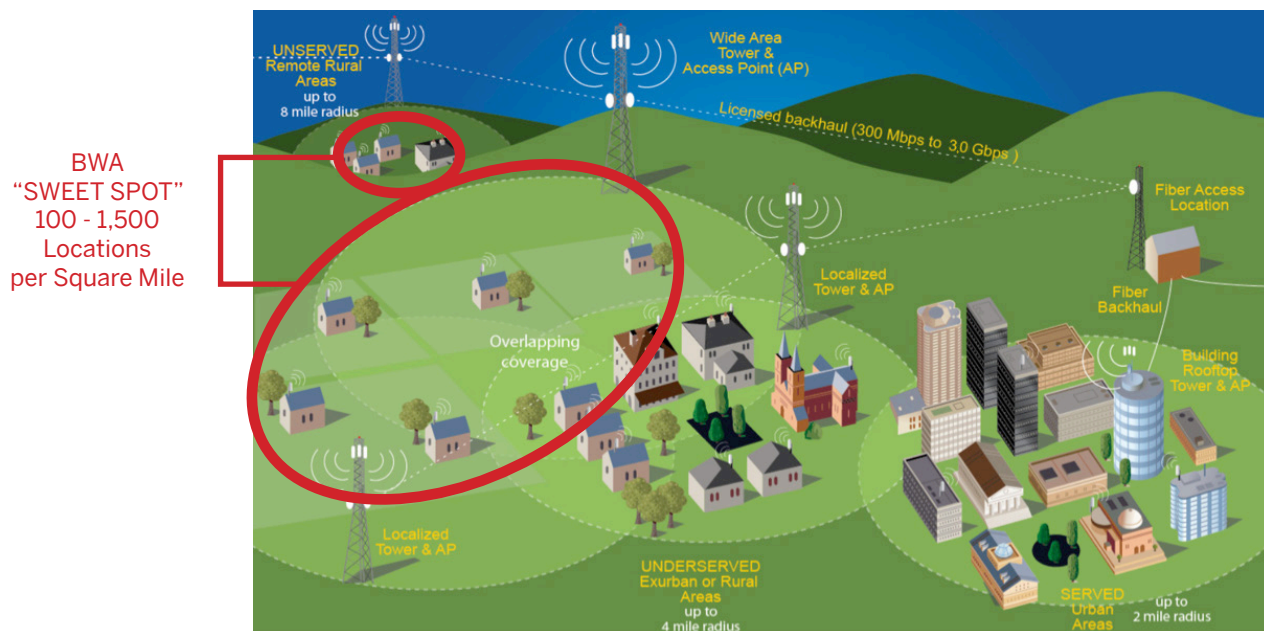
BWA providers typically employ a variety of licensed and unlicensed spectrum to deliver their services. For last-mile, point-to-multipoint connections, unlicensed spectrum bands such as 900 MHz and 2.4 GHz were

commonly used in the early years of the industry. However, these bands have given way to 5 GHz, 3.65 GHz, and 2.5 GHz to accommodate increasing speed, coverage, and capacity needs. Unlicensed 5 GHz and licensed 6-24 GHz point-to-point connections are most commonly used to connect towers and serve high-volume enterprise customers, with FCC microwave licenses readily available at nominal cost.

Equipment designed for use in unlicensed spectrum bands is limited in power output to reduce interference to other users, as mandated by the FCC, and is designed to perform well in environments with more potential for interference than equipment designed for use in exclusively licensed bands.

The BWA "sweet spot" – where providers can offer the best service and economics – is often in exurban areas with 100 to 1,500 locations per square mile, such as those shown on the left side of Figure 2.

**FIGURE 2:** Typical BWA Network Architecture



# BWA: A Solution to the Broadband Gap

America's broadband performance is middling at best. According to the Organization for Economic Cooperation and Development (OECD), in 2015 the United States was ranked 15th out of 34 member nations in the number of fixed broadband subscriptions per 100 inhabitants.

- Only 4 percent of urban Americans lack access to 25 Mbps/3 Mbps broadband.

The United States faces a variety of challenges that have made it difficult to ensure universal broadband coverage. Chief among them are low population density and rugged

terrain in large portions of rural America. BWA providers using fixed wireless technology can be a large part of the solution, largely because of their favorable economics. (See Figure 6.)

Bringing broadband to under-served markets is a difficult challenge. At this time, BWA providers using wireless technologies are the most cost-effective solution in vast areas of the United States and the world.

And according to the [FCC's 2016 Broadband Progress Report](#):

- 10 percent of all Americans (34 million people) lack access to 25 Mbps/3 Mbps service; and
- 39 percent of rural Americans (23 million people) lack access to 25 Mbps/3 Mbps; but

Without BWA providers, America's broadband gap already would be much larger. The data further suggests that many under-served Americans reside and do business in rural areas where BWA providers are thriving, validating the opportunity for them to become a key part of the solution to America's broadband gap.

## International Proof of Concept

BWA providers are more common in some nations than in the United States, in most cases because cable and other broadband infrastructure is non-existent, aging, and/or very expensive to install and upgrade. For example, Australia, Canada, Italy, the Philippines, and Russia all have BWA providers with customer counts in the hundreds of thousands, or in the case of the Philippines, millions. Developing nations present significant growth opportunities for the industry.

Non-U.S. demand for BWA services has pushed the technology forward. Innovators like Cambium Networks, Ericsson, Huawei, Mimosa, Nokia, Ubiquiti, and ZTE are competing in both established and emerging markets around the world.

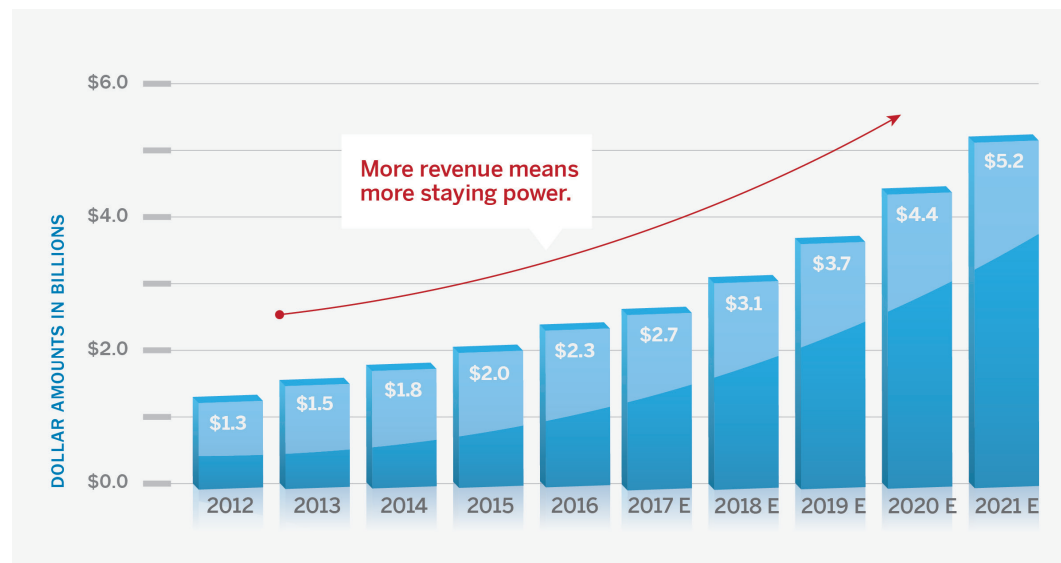
The notion of "carrier grade" fixed wireless was not widely accepted in the past, but it is now becoming more prevalent in the United States and worldwide.

# U.S. BWA Growth Forecast

The Carmel Group estimates that the current upward trajectory of BWA industry revenues in the United States will continue for at least the next five years. (See Figure 3.) Core BWA industry revenues from provision of service to end-users were estimated conservatively at \$2.3 billion in 2016. These are expected to rise to more than \$5.2 billion by the end of 2021.

Drivers of growth include explosive consumer demand for broadband services, continuing deployment to unserved and under-served areas, commercial and business demand, improvements in technology at competitive prices (including standards-based LTE equipment), and the combination of existing services with ancillary services that are increasing the average revenue per unit (ARPU).

**FIGURE 3: U.S. BWA Industry Revenue Review and Forecast**

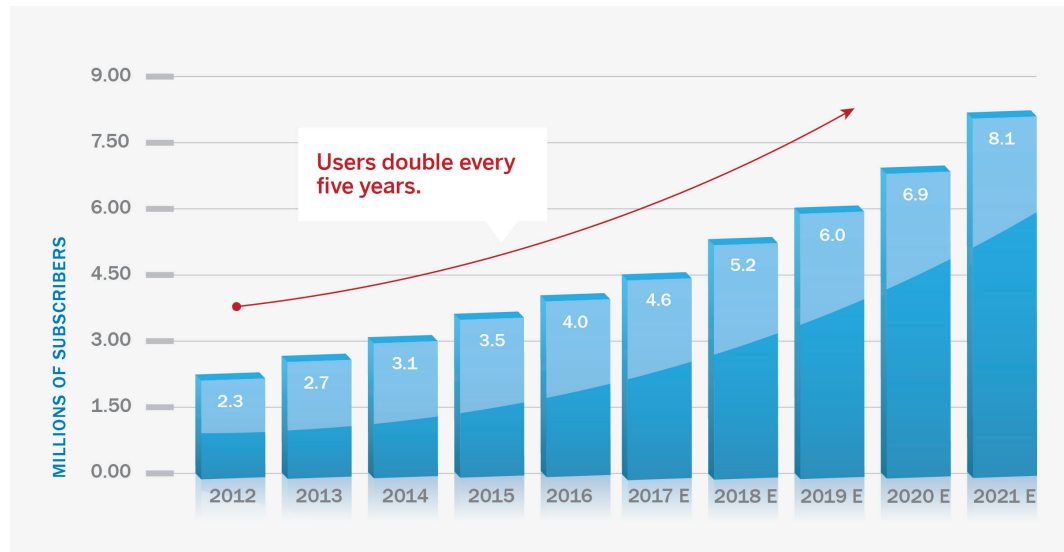


Source: The Carmel Group  
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The Carmel Group believes that customer subscriptions will roughly double, from 4.0 million in 2016 to 8.1 million in 2021, as BWA providers expand in under-served areas and

contend effectively in the burgeoning number of areas where they offer superior customer service and a local presence. (See Figure 4.)

**FIGURE 4: U.S. BWA Customer Growth**

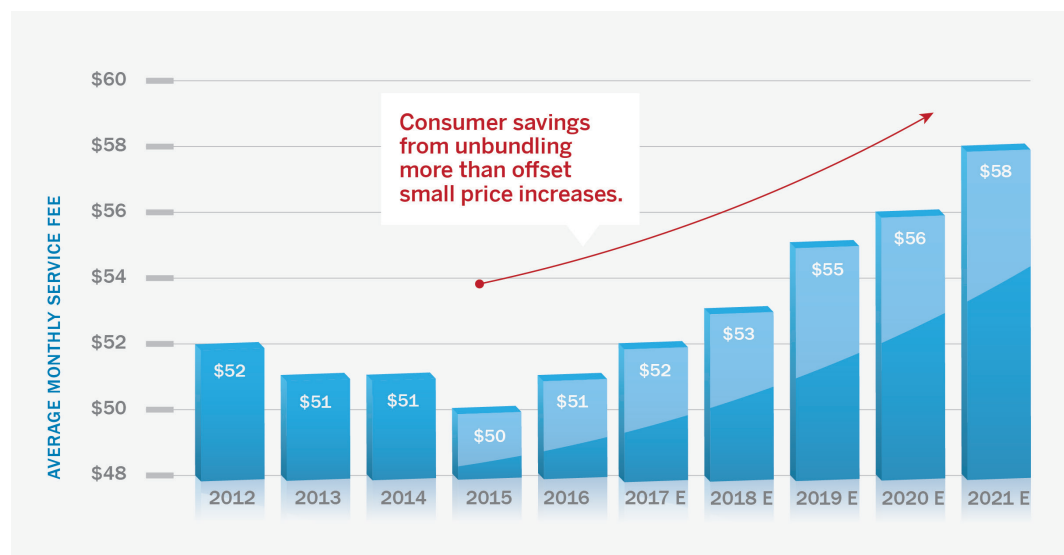


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The Carmel Group believes that per-customer monthly revenue also will continue to rise, in part because consumers will be willing to pay more for the improved services and speeds

that will flow from network upgrades, standards-based technologies, and ancillary services. Figure 5 depicts our projections.

**FIGURE 5: U.S. BWA Average Monthly Billing Review and Forecast**



Source: The Carmel Group  
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# Seven Key Growth Drivers

The BWA industry is experiencing robust growth in the United States and worldwide. The Carmel Group expects this growth to accelerate for at least the next five years, due to seven key growth drivers:

- 1** The economics of wireless technology enable network deployments at a fraction of the cost of wireline.  
.....
- 2** The economics of unlicensed spectrum and trends in spectrum regulation are favorable to fixed wireless.  
.....
- 3** Consumer demand for broadband connectivity and associated applications, especially video, is surging at an exponential rate.  
.....
- 4** Global standards-based technologies, such as LTE and 5G, and a growing equipment ecosystem are being leveraged for fixed wireless applications.  
.....
- 5** Industry consolidation, a healthy funding environment, and greater support from government are driving investment.  
.....
- 6** New entrants and hybrid networks are validating the business model.  
.....
- 7** New markets and categories such as home automation, security, and the Internet of Things (IoT) present further opportunities for fixed wireless.  
.....

We delve further into each of these drivers below.



## 1 Fixed wireless costs less

The economics of fixed wireless are already very attractive and only becoming more so. For example, it costs nothing to install, maintain, or repair the spectrum resource, and fixed wireless equipment is inexpensive relative to fiber, coax, and twisted pairs – all of which incur extensive installation, maintenance, and repair costs. (See Figure 6.)

Moreover, upgrading fiber, cable, satellite, or mobile broadband is highly capital intensive. For these technologies, each generation of improvement requires significant network upgrades. In contrast, BWA networks can be scaled incrementally over time.

Advances in radio technology are improving wireless speeds to the point where they are approaching cable and ultimately will catch up to fiber. Industry standards and software-defined radios enable incremental upgrades without leaving past customers behind.

The following figure compares relative capital expenditures per residential subscriber, as well as speed, upgrade costs, average revenue per unit (ARPU), and payback times for the five most popular U.S. broadband technologies.

This is a relative presentation comparing the four other technologies to BWA, which is set to an index value of 10. Fiber costs about 7x BWA costs; Cable is 4.5x more. Satellite costs about the same per sub, but this analysis excludes the cost of satellites because network costs vary greatly. Mobile's capex per sub is a little more than 2x BWA's, although it offers mobility. As household density drops, capex for wireline rises but remains relatively constant for wireless.

This analysis suggests that with a payback period of just under one year, BWA offers the most attractive economics of the top U.S. broadband technologies.

The estimates for fiber, cable, and BWA assume the indicated speeds and average network reach. Satellite and mobile data are estimated from national averages. In an effort to present a rational and fair relative cost analysis, The Carmel Group constructed several cost models for each technology. The Relative Capex/Subscriber reflects a blend of these models with some analytical adjustment. Actual results vary.

**FIGURE 6: Residential Consumer Broadband Comparative Economics**

	FIBER	CABLE	SATELLITE	MOBILE	BWA
<b>CAPEX/SUB RELATIVE TO BWA <sup>(1)</sup></b>	70	45	10.5 <sup>(2)</sup>	21	10
<b>SPEED <sup>(3)</sup></b>	1 Gbps	150 Mbps	12-35 Mbps <sup>(4)</sup>	10–12 Mbps	100 Mbps
<b>UPGRADE COSTS</b>	MODEST Only the fiber remains the same	HIGH Complete CPE & network change	LOW/HIGH Incremental upgrades until the satellite fails	HIGH Complete device & network change	MODEST Incremental upgrades in CPE and network
<b>BROADBAND ARPU</b>	\$69	\$42	\$61	\$59	\$51
<b>PAYBACK PERIOD</b>	60 months	38 months	12 months	21 months	11.5 months

Sources: Wisper ISP, National Rural Telecommunications Cooperative, and The Carmel Group.

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(1) This is a relative presentation comparing all of the technologies to BWA, which is set to an index value of 10. See above for explanation.

(2) Does not include the cost of satellites.

(3) Max speeds; most service providers are not yet offering max speed. For cable, the DOCSIS 3.0 standard is capable of 1 Gbps. For BWA, point-to-point links and millimeter-wave, point-to-multipoint connections can provide more than 1 Gbps to end users.

(4) Anticipated typical speed.



## 2 Spectrum trends favor fixed wireless

The BWA industry's ability to use unlicensed spectrum is another growth driver.

Unlicensed spectrum is free to its users. Licensed spectrum requires capital investments at high prices, which are ultimately passed on to consumers.

Another advantage is rapid deployment. There is no need to go through lengthy regulatory proceedings and auctions to acquire access to the airwaves. In addition, the recent introduction of LTE technology in certain bands opens up an enormous, global-standards-based ecosystem for equipment and carrier-aggregation technology, adding another boost to the speed, capacity, and economics of BWA deployments and upgrades.

The Carmel Group's extensive survey of BWA operators revealed that relatively few spectrum bands support today's BWA industry. (See Figure 7.) However, the FCC is

exploring new bands that are expected to be well-suited for BWA networks, including the Citizens Broadband Radio Service band (3550-3700 MHz, called CBRS), TV white spaces, and several extremely-high-frequency, millimeter-wave bands. Industry efforts are also underway to expand geographically licensed areas in the LTE-grade 2.5 GHz band.

The growing acceptance of spectrum sharing is further increasing availability and capacity for fixed wireless, with greater overall spectral efficiency.

It is important to realize that unlicensed spectrum is not *unregulated* spectrum. Even in unlicensed bands, the FCC regulates acceptable equipment, power limits, frequencies, and interference. BWA providers stay within those limits and use a variety of frequencies and network design features to overcome population density, terrain, and propagation obstacles.

**FIGURE 7: Spectrum Bands Most Commonly Used by the BWA Industry**

FREQUENCY	500-700 MHz	902-928 MHz	2.4 GHz	2.5 GHz	3.55 – 3.7 GHz	5.15- 5.85 GHz	28 & 39 GHz	>40 GHz
COMMON NAME	White Space	ISM	ISM/Wi-Fi	EBS/BRS, LTE Band 41	CBRS, LTE Band 42, 43 & 48	U-NII 5 GHz Wi-Fi Band 33	LMDS, TN	Millimeter Wave
LICENSE	ASA*	EXEMPT	EXEMPT	LICENSED	ASA, PAL or GAA	EXEMPT	LICENSED	VARIOUS
INTERFERENCE RISK	Medium	High	High	Low	Low, Medium	High	Low	Low
BAND SIZE	Varies by Location	26 MHz	83.5 MHz	194 MHz	150 MHz	580 MHz	1.2 GHz 1.4 GHz	6.2 GHz
NLOS ABILITY	Excellent	Excellent	Fair	Good	Fair	Poor	Poor	Poor
PRIMARY TECHNOLOGY	802.11af "Super Wi-Fi"	Proprietary TDD	Wi-Fi	LTE	Proprietary, WiMax and LTE	Wi-Fi, LTE-U	5G	5G

\* Authorized Shared Access  
Source: The Carmel Group

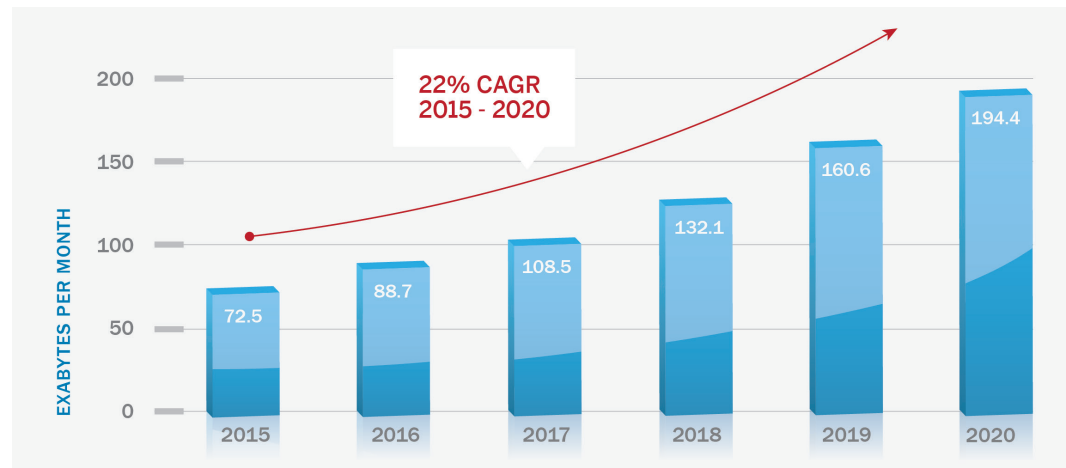
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### 3 Video is fueling overall growth in demand for broadband

The demand for broadband access to the internet is growing at an exponential rate. Figure 8 presents Cisco's 2016 assessment and forecast of overall internet traffic mea-

sured in gigabits per second (Gbps). Consumers are defining their internet access needs in terms of both speed and throughput.

**FIGURE 8:** Rising Global Internet Traffic



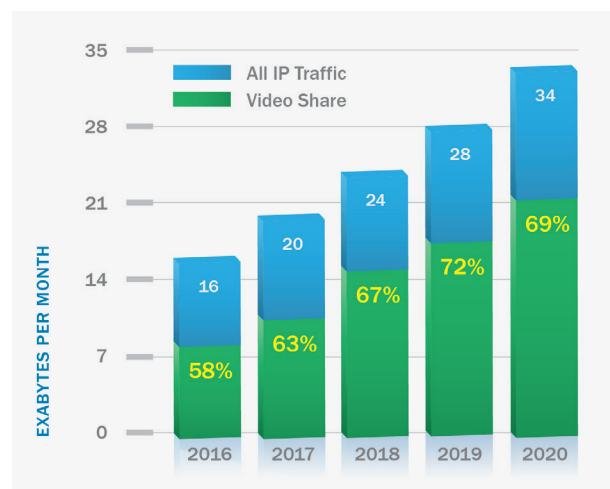
Source: Cisco Visual Networking Index 2016

Video is a major driver of broadband demand. Figure 9 presents Cisco's 2016 assessment on how video will drive broadband demand in terms of quantity (exabytes) of data moved.

Video accounts for a rapidly growing share of internet traffic. Cisco projects a 22% compound annual growth in overall internet traffic between 2015 and 2020, but it expects video traffic alone to grow 31% annually over the same time frame.

The reasons for this are clear. A growing number of consumers are unbundling from pay TV services and replacing expensive programming bundles with less expensive "over the top" (OTT) access via broadband. BWA providers make this cost-saving option – once available only to urban dwellers – available to rural and exurban customers.

**FIGURE 9:** OTT is Driving Internet Growth



Source: Cisco Visual Networking Index June 2016

We do not expect this trend will slow. If anything, we expect unbundling will accelerate as more consumers embrace Internet-based programming and watch programs on wireless devices at times of their choosing.

## 4 Standards-based technologies give providers more choices

Every significant advancement in mobile technology is paying dividends in the fixed wireless arena as well. For example, standards-based LTE technology, which originated in mobile standards bodies, is being deployed in fixed networks to give BWA providers greater speed, capacity, and credibility as service providers.

The benefits of unlicensed spectrum are so powerful that many mobile carriers are planning to augment licensed networks with LTE over unlicensed spectrum.

The WISP industry started with consumer and enterprise-class technology. These technologies were sometimes cumbersome to manage and upgrade. But because of rising world demand, today's BWA providers have an array of suppliers and technologies. Indeed, carrier-class technology is rapidly gaining share among BWA providers. This competition, together with enhanced global research and development and related investments, is enabling the technologies and services to improve more rapidly.

## 5 Capital availability and government support are growing

As noted in this report, BWA providers generally do not hold licenses for the spectrum they use. The lack of a tangible medium such as fiber, copper, or licensed spectrum has deterred financial institutions from investing in BWA providers. Other investor concerns have included low barriers to entry by competitors, signal interference, and alleged "unreliability" of unlicensed spectrum.

However, more than a decade of successful operations, validation from new entrants, recent standards-based equipment deployments, and the advance of successful consolidators like Rise Broadband have all improved capital availability. Today, the financial markets are beginning to recognize the favorable economics of fixed wireless and BWA providers. The validity of licensed spectrum at 2.5 GHz is also emerging, as illustrated by larger BWA providers such as Michigan-based SpeedConnect.

Meanwhile, the federal government is considering regulatory changes that could open up more opportunities for BWA providers. For example, the FCC and U.S. Department of Agriculture are eyeing plans to make broadband subsidy programs less oriented to incumbent telecom providers, more technology-neutral, and more focused on cost-effectiveness and speed of deployment. Spectrum sharing initiatives are underway to provide additional unlicensed and affordable spectrum licenses to service providers. And the new chairman of the FCC, Ajit Pai — having himself grown up in rural America — has developed a 'Digital Empowerment Agenda' to prioritize expanded access to broadband in under-served areas of the United States.

## 6 New entrants are validating the business model

The arrival of major new entrants is signaling a wave of growth in fixed wireless and the BWA sector. Google, AT&T, Verizon, Windstream, and other carriers have recently announced plans to deploy more fixed wireless, generally as an extension of their wired services. Many of these efforts target rural areas and are supported by the federal Connect America Fund. Other efforts target multi-dwelling units

(MDU) and commercial customers in urban and suburban areas.

These new entrants will further validate the business model and lend BWA providers greater credibility in capital markets and the halls of government. Long term, these companies could pose a competitive threat or present exit opportunities for smaller providers.

## 7 New markets and service categories = more opportunities

To date, fixed wireless technology has been most successful in rural America, where it offers high-grade service in areas with limited alternatives, locally based customer service, and superior economics compared to other broadband options.

However, BWA providers are beginning to enter higher-density markets due to the new technologies available, the faster deployments possible, and the improving access to capital. For example, industrial parks, residential communities, and government or institutional facilities are often found on the fringes of urban areas. Urban enterprise zones often have aging infrastructure and indifferent incumbent providers. We see growth in urban deployments utilizing 5G millimeter-wave technologies, which deliver high-capacity, high-speed services, albeit at shorter distances.

For all the reasons described in this report, BWA providers are well positioned to compete in these neglected markets as well. The Carmel Group expects these higher-density markets could grow to represent 30 percent or more of industry revenues in the five- to ten-year time horizon.

On another front, the advances in equipment are enabling wireless networks to dramatically reduce latency, i.e., the delay between transmitting and receiving data. Broadband applications that depend on speed, reliability, and low latency – such as gaming, video-on-demand, the Internet of Things (IoT), and data backup for business and government – are among the most robust segments in the broadband market.

BWA operators interviewed for this report also noted that home security and automation systems are ancillary services that can be conveniently packaged with fixed wireless broadband.

These growth drivers are not yet factored into our current growth forecast, which means the BWA outlook could have even more upside than that projected here.

# Fixed Wireless Versus Other Technologies

The various telecommunications technologies have “pros and cons” that affect their suitability for various market requirements. The gaps in any one technology present clear opportunities for the others. Fixed wireless competes well with many of the alternatives. (See Figure 6.)

## VERSUS MOBILE/CELLULAR

Mobile/cellular networks were developed for mobile voice service; data-intensive applications came much later. In the mobile arena, customers typically buy a quantity of data per month and face extra charges or service restrictions if they exceed data caps.

Mobile carriers typically use licensed spectrum in the 700 MHz to 2.5 GHz range, which they buy at FCC auctions or on the secondary market. These costs are passed through to consumers. On top of spectrum costs, the equipment needed to run mobile networks costs substantially more to own and operate than fixed wireless equipment.

Fixed wireless BWA systems do not provide for mobility. However, they can ensure high reliability and efficient carriage of large volumes of data for customers in fixed locations through the use of large, outdoor, directional antennas.

The mobile/cellular industry also spreads supply, operations, and maintenance among a dizzying array of consumer electronics companies, equipment vendors, and telephone companies.

In contrast, fixed wireless providers typically do it all. They buy, install, and maintain everything in their network, from the “backhaul” into the system base, to the towers, to the fiber, to the consumer premises equipment both inside and outside their customers’ buildings.

## VERSUS DSL, FIBER, CABLE AND SATELLITE

A remarkable 74% of American households have only one local provider of broadband connections that can meet the FCC’s broadband speed standard of 25 Mbps download and 3 Mbps upload – consistently and at attractive prices. This fact alone indicates the need for policies to encourage more investment and competition.

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Fixed wireless BWA systems do not provide for mobility. However, they can ensure high reliability and efficient carriage of large volumes of data for customers in fixed locations.

In the mobile arena, tiny antennas that fit inside of a handheld device and transmit signals on-the-go are the norm. Sadly, customers can do little but accept spotty connections and dropped calls caused by poor reception on the handheld device.

In areas where consumers have two or more options, telco-provided Digital Subscriber Line (DSL) service is often the only competitor to fixed wireless. However, DSL is comparatively slow and costs considerably more to deploy and upgrade than other technologies.

Many of the BWA leaders interviewed for this report said fiber-to-the-home (FTTH) tends to be their fiercest rival in those limited areas where FTTH is available. Previously-deployed-but-unused fiber provides good throughput and tends to be cost-competitive to the consumer. The economics of new fiber tend to limit it to higher-density markets and higher-traffic tower links.

Cable tends to be limited to more densely populated areas, and many cable systems still deliver services via aging infrastructure. State-of-the-art cable tends to be limited to the most profitable markets. Thus, BWA providers enjoy several advantages over cable broadband in terms of reaching more far-flung customers with reliable, speed-competitive service, even in urban and suburban environments.

The relatively high latency of satellite broadband limits its use for gaming and other low-latency applications. BWA providers, cable, fiber, and mobile are all better suited for latency-sensitive applications.

Data caps among satellite providers further reflect the relative scarcity of today's satellite broadband capacity. Conversely, data caps among BWA providers are quite rare.

However, it is worth noting that BWA providers may occasionally team up with satellite broadband providers to offer broadband where typical terrestrial wireless services are not available.

# BWA Providers Face Challenges

While the outlook for the BWA industry is highly positive, there are a number of challenges:

- Across the telecommunications and media industries, there are intense competitive pressures and aggressive efforts by all kinds of service providers to attract and retain customers.
- Policymakers at all levels are less familiar with BWA providers and fixed wireless than they are with larger incumbents using traditional technologies. Hence, there tends to be a lack of policy support for BWA providers and, indeed, there are many policies that tend to favor incumbent competitors.
- Detractors raise concerns about the sustainability of unlicensed spectrum and spectrum sharing.
- Several of the largest broadband competitors – specifically telcos and cable companies – have acquired significant interests in content companies, giving them the ability to offer consumers attractive service packages that feature their favorite networks and shows. As mostly small businesses, BWA providers cannot compete with large, vertically integrated companies in this arena.
- The industry's comparatively small size, especially on an average individual company basis, together with its lack of scale and consolidation, affect its ability to educate investors, legislators, regulators, media, and the general public.

## Conclusion

The Carmel Group believes that the fixed-wireless-based, Broadband Wireless Access industry will continue to experience robust growth in revenues, subscribers, and investment, as well as increasing recognition in the United States' telecommunications regulatory scheme – all primarily because of the many favorable conditions and trends described above.

Telecommunications industry stakeholders, investors, and policymakers can look forward to exciting days ahead for the BWA industry.

# Appendix

As part of the extensive research conducted for this report, in Q4 of 2016 The Carmel Group received survey results from 169 Broadband Wireless Access (BWA) operators, who answered 80 questions on a variety of business issues. The response rate was an above-average 30% of the entire survey sample. An additional BWA manufacturer/vendor survey was also completed.

Topic areas of the Operator Survey included current subscribers, future subscribers, customer service, equipment, services, competition and competitive advantages, and business issues.

The BWA operators' answers to four of the 80 survey questions are provided below. These charts show that:

**Subscribers:** Many BWA operators experienced robust growth in the number of new

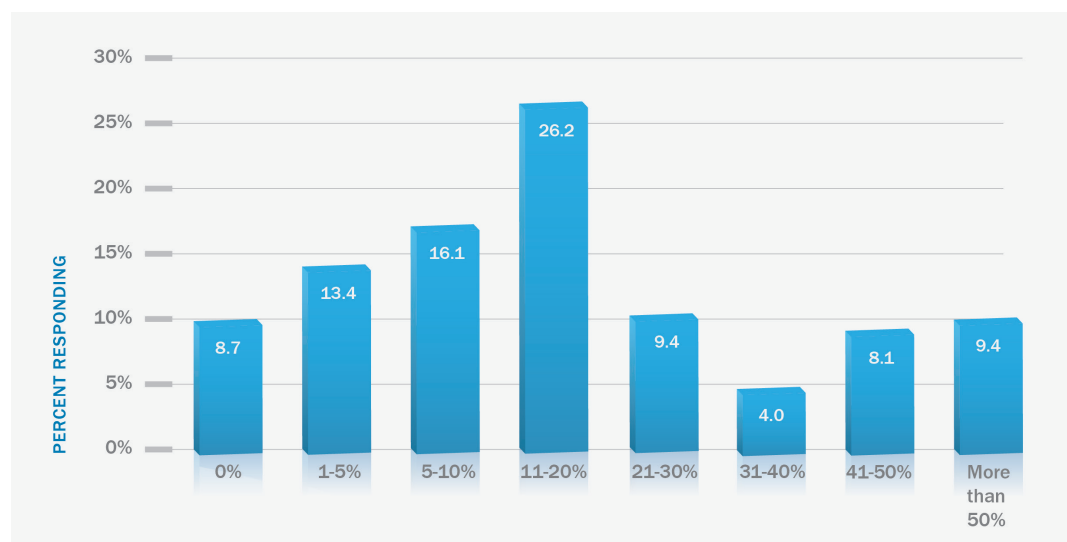
residential subscribers from 2015 to 2016, with roughly half reporting growth of 11% or more.

**SAC:** Most of the respondents reported Subscriber Acquisition Costs (SAC) in the range of \$200 to \$400, which compares quite favorably to the SAC reported by cable, telco, and satellite providers for delivery of their video and broadband service.

**ARPU:** Most respondents reported average revenue per unit (ARPU) in the range of \$40 to \$70, with the highest number of respondents having an ARPU in the \$51-60 range.

**Churn:** Most responding BWA operators experience low subscriber turnover relative to the competitors mentioned above, suggesting that those providers produce and deliver a highly satisfactory broadband product.

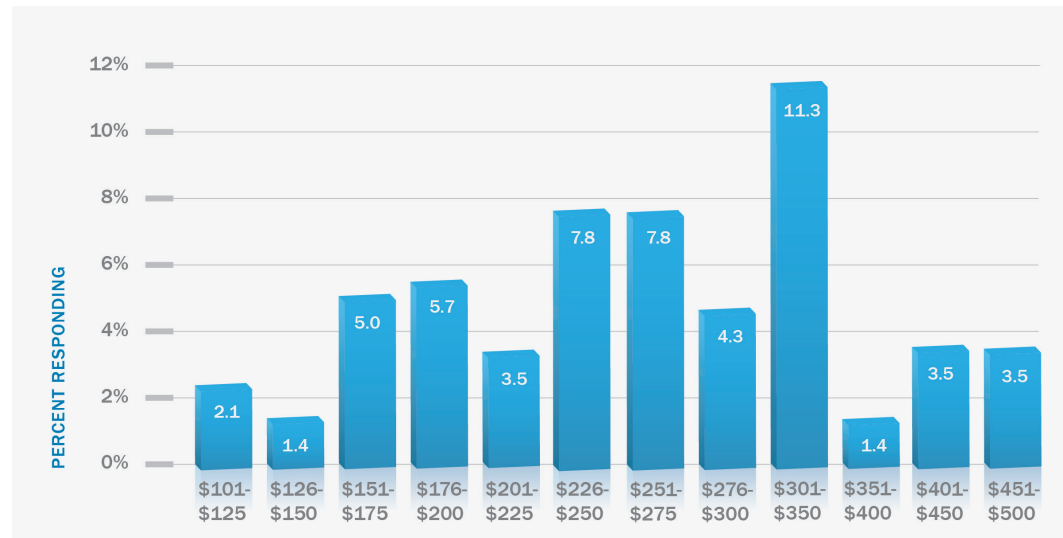
**FIGURE 10:** What was your actual or best estimate of the annual residential subscriber growth percentage rate for your company during the past year?



Source: The Carmel Group  
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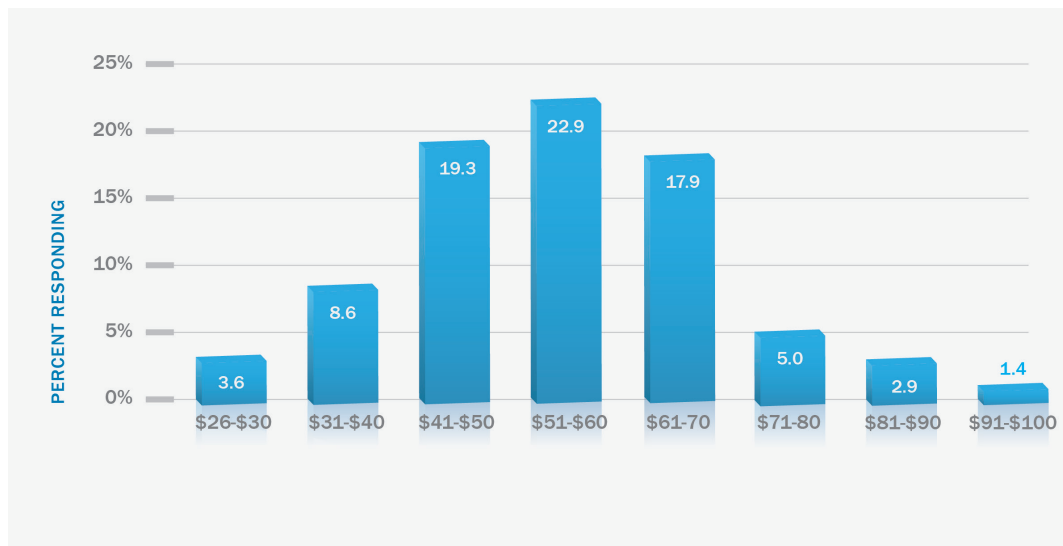


**FIGURE 11:** What is your company's average Subscriber Acquisition Cost (SAC) for a new residential customer?



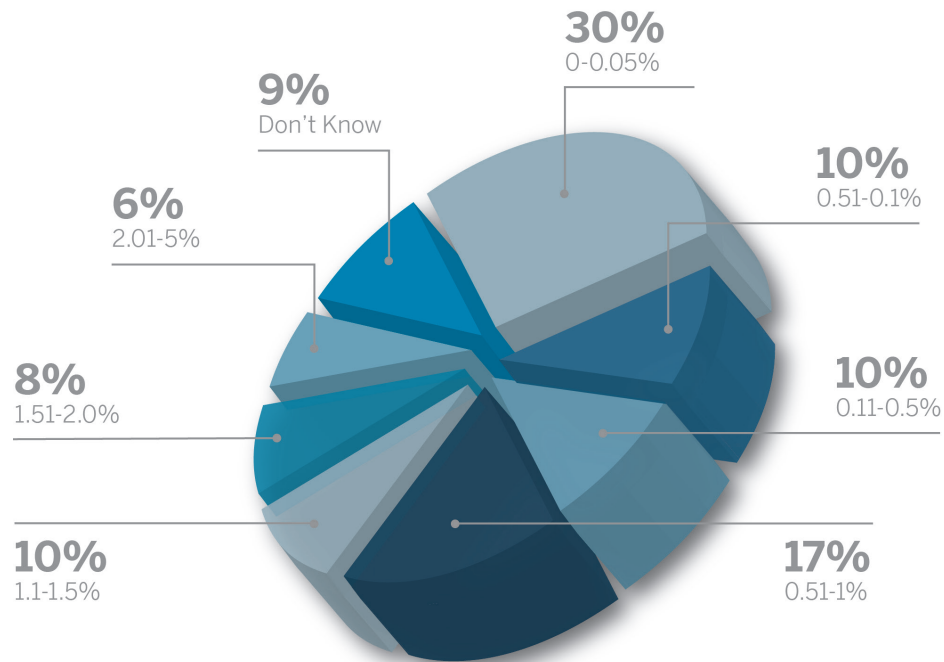
Source: The Carmel Group  
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**FIGURE 12:** What is your company's most recent figure for average revenue per unit/subscriber (ARPU) for only residential users?



Source: The Carmel Group  
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**FIGURE 13:** What is your company's average monthly churn (or turnover) rate for the past year (take your average number of disconnected subscribers in a given month and divide that by your subscriber base at the beginning of month)?



Source: The Carmel Group  
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## Appendix D

### List and Summary of Selected Experimental Authorizations in the 3550-3650 MHz Band

***Digis LLC (Call Sign WI2XKN)*** – Operating as Rise Broadband, the country’s largest WISP with approximately 200,000 customers, Digis is conducting a market trial in Utah County, Utah to “inform its business, investment, technology and deployment decisions as it plans for expansion of its broadband networks” and to determine “the value and utility of PALs.” The trial is currently providing service to more than 200 customers.

***SkyWerx Industries (Call Sign WU2XTF)*** – SkyWerx is a WISP serving rural Colorado. Its trial purpose is “to determine the financial and technical viability of the CBRS band and assess consumer acceptance at various speeds and price points.”

***Speedwavz LLP (Call Sign WI2XOC)*** – Speedwavz, a WISP based in rural Richwood, Ohio, explained that “[w]e want to test the feasibility of connecting LTE Access Points to SAS database in the new proposed 3.5 band. This will provide broadband in rural underserved areas. We plan to run tests in collaboration with the manufacturer so that they can ensure their equipment operates as designed, and plan to obtain permanent PAL license when that becomes available.”

***CellTex Networks, LLC dba ZipLink (Call Sign WI2XYI)*** – ZipLink is a WISP based in South Texas that obtained an experimental license to test LTE equipment manufactured by different companies. In the trial, ZipLink plans to determine the best balance of cost and performance to inform its financial modeling and to assess consumer acceptance at various performance and price points.

***First Step Internet, LLC (Call Sign WI2XYD)*** – First Step, a fixed wireless broadband provider in rural Idaho, plans to conduct an experiment to gain information on future expansion and network investment plans. First Step also has proposed to serve identified unserved areas that are funded through the Commission’s rural broadband experiment program.

***Plexicomm, LLC (Call Sign WI2XVY)*** – Plexicomm, a fixed wireless broadband provider, describes its planned experiment as a way to quantify any differences in customer satisfaction between the Cambium PMP450 and its existing WiMAX connections. Note that this trial does not include LTE equipment.

***ExteNet Systems, Inc. (Call Sign WI2XKQ)*** – ExteNet, a neutral host service provider, obtained an experimental license “to test and demonstrate prototype high-speed wireless data infrastructure communications equipment that will operate in the 3.5GHz Band” at its indoor facilities.

***SpiderCloud Wireless, Inc. (Call Sign WI2XXS)*** – SpiderCloud Wireless is a startup company that is designing 3G/4G small cells for outdoor enterprise applications.

***Broadcast Sports International (multiple call signs)*** – The licensee is a video production company that provides video for broadcast, satellite broadcast and cablecast of sporting and other events. It explains that “the spectrum usage in many major cities and the limited available spectrum for these events makes it necessary to make coordinated, temporary use of additional channels in the vicinity of 3.6 GHz.”

***The Walt Disney Corporation (Call Sign WI2XTG)*** – Disney is testing equipment at its Disneyland and Disney World venues in California and Florida.

***Rice University (Call Sign WI2XLO)*** – Rice University is conducting a trial on its campus to test “a first-of-its-kind multi-cell wireless network research platform capable of massive MIMO” pursuant to a National Science Foundation grant.

***Artis, LLC (Call Sign WI2XXK)*** – Artis is funded by the U.S. Army and develops tank protection systems using radar to detect and track projectiles. It is testing the capabilities of this software-defined radar technology using its experimental license.

***5D Robotics, Inc. (Call Sign WK9XYX)*** – 5D Robotics is an IoT software company that plans to test ultra-wideband devices attached to street lamps and vehicles in order to track vehicles in Manhattan and Brooklyn, New York.

***Caterpillar, Inc. (Call Sign WI2XHO)*** – Caterpillar is a manufacturer of diesel motors, heavy construction, and mining equipment, and plans to use its experimental license to test the equipment that relies on embedded LTE devices and uses Wi-MAX to operate autonomously.

***Xvergent Networks (Call Sign WJ2XCG)*** – Xvergent is a fixed wireless broadband provider in rural Pennsylvania that plans to test “LTE equipment on 20-megahertz channels in a challenging topographic and geographic environment” with its experimental license because the larger 20-MHz channel sizes are not available in another band in which it operates.

***ViaSat, Inc. (Call Sign WI2XQD)*** – ViaSat is a broadband internet provider and antenna manufacturer that plans to simulate a satellite using its experimental license in order to test the performance of its antennas and ensure the antennas meet ViaSat’s design specifications.

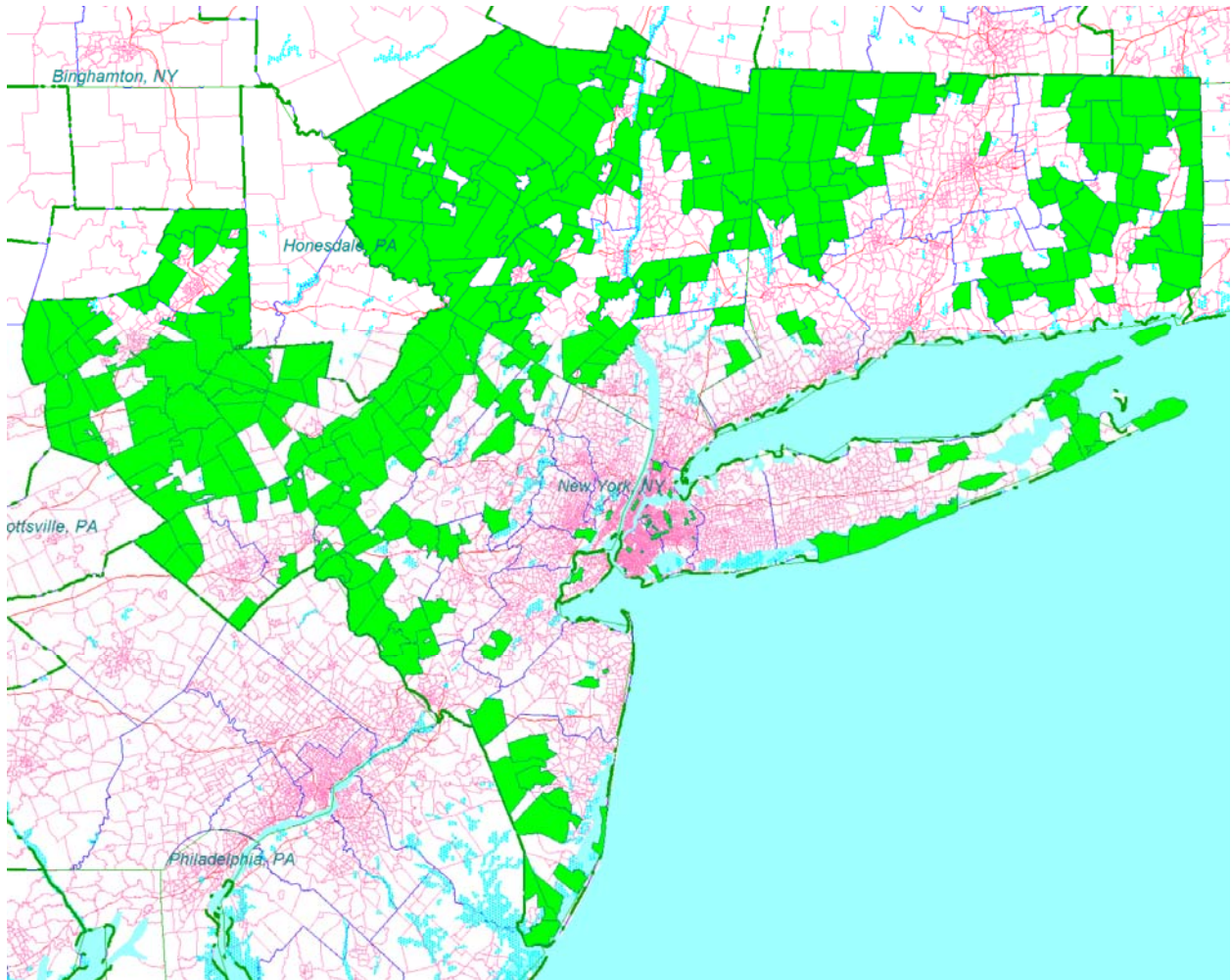
***TGM Pinnacle Network Solutions LLC (Call Sign WJ2XDC)*** – Pinnacle is testing equipment with software-defined radios to assess their features and determine their ability to provide last-mile broadband service to broadband customers in rural North Texas.

***Clarity Telecom, LLC dba Vast Broadband (Call Sign WJ2XED)*** – Vast Broadband plans to test whether the CBRS band will improve the transmission of broadband service through dense tree coverage in rural South Dakota.

## Appendix E

### Map of PEA 1 and Constituent Census Tracts

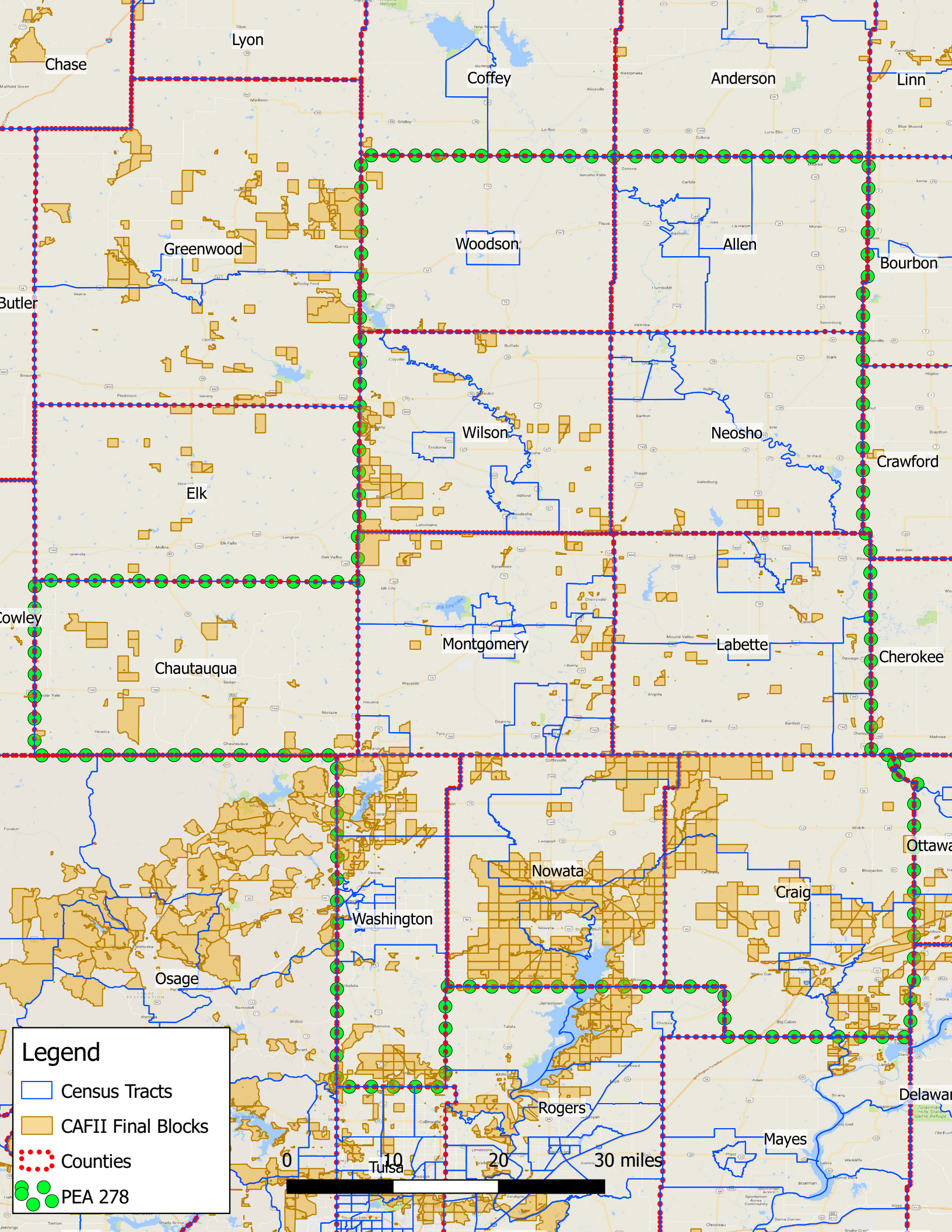
Census tracts (in green) in PEA1 having an area of at least 10 square miles. These have an average population density of 79 per square mile. Other census tract boundaries are in pink.



## **Appendix F**

### **Map of PEA 278 and Constituent County, Census Tract and CAF Areas**





**Legend**

- Census Tracts
- CAFII Final Blocks
- Counties
- PEA 278

## Appendix G

### Census Tract Density Tables

Table 1  
All PEAs

Land area in square mi.	Number of tracts	Total square miles in tracts	Percentage of total land area	Population in tracts	% of total population	Average density
<10	53,910	100,976	2.9%	222,197,682	71.1%	2200.5
>=10	20,092	3,434,353	97.1%	90,273,645	28.9%	26.3

Table 2  
PEAs with population of <1,000,000

Land area in square mi.	Number of tracts	Total square miles in tracts	Percentage of total land area	Population in tracts	% of total population	Average density
<10	41,482	66,564	1.9%	173,672,481	55.6%	2,609.1
>=10	6799	431,035	12.2%	34,045,064	10.9%	79.0